

**DIRECTORATE FOR EDUCATION  
CENTRE FOR EDUCATIONAL RESEARCH AND INNOVATION (CERI) GOVERNING BOARD**

**Educating for Innovative Societies**

**Conference Summary Report**

**26 April 2012**

*In the framework of its “Innovation Strategy for Education and Training” ([www.oecd.org/edu/innovation](http://www.oecd.org/edu/innovation)), the OECD Centre for Educational Research and Innovation (CERI) hosted a conference on “Educating for Innovative Societies” on 26 April 2012 in Paris.*

*This document summarises the conference presentations and discussions.*

*The conference discussed how science, mathematics, and arts education contribute to the development of skills for innovation, and how skills in thinking and creativity could be assessed in the school context. Prof. Howard Gardner (Harvard University) opened the conference, sharing his views on how multiple intelligences can be nurtured, creativity cultivated, and engagement and ethics promoted through education.*

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## Conference Summary Report

### EDUCATING FOR INNOVATIVE SOCIETIES

**Conference organised by the  
Organisation for Economic Cooperation and Development (OECD)  
Paris, 26 April 2012**

1. The OECD conference “Educating for Innovative Societies” discussed the goals of education in innovation-driven societies and how curricula, teaching methods and assessment practices can empower people for innovation. The objectives of the conference were: (1) to present the findings of the forthcoming OECD report on arts education’s role in developing skills for innovation-driven societies; (2) to present and discuss evidence and policies in mathematics and science education that can lead to better skills in thinking and creativity; (3) to present and discuss innovative assessment tools that raise awareness and provide formative and summative feedback on other skills than disciplinary skills.
2. The conference gathered some one hundred participants from 30 different countries.

#### **Session 1: Opening**

3. In his opening address, Dirk Van Damme (OECD Directorate for Education) welcomed the participants and presented an overview of the work on skills and education for innovation at the Centre for Educational Research and Innovation (CERI). The “Innovation Strategy for Education and Training” project, in particular, brings together research evidence on pedagogies, curricula and assessments that foster different individual skills for innovation. Skills for innovation refer to (1) technical skills, (2) skills in thinking and creativity as well as (3) behavioural and social skills.

#### **Session 2: Conversation with Howard Gardner**

4. Howard Gardner, the John H. and Elisabeth A. Hobbs Professor of Cognition and Education at the Harvard Graduate School of Education and Senior Director of Harvard Project Zero was first interviewed by Stéphan Vincent-Lancrin and Bruno Della-Chiesa (OECD Directorate for Education), who then moderated the conversation with the conference participants.

#### *Multiple intelligences*

5. At the outset, Howard Gardner was asked to clarify the relations between the concepts of “*intelligences*”, “*skills*”, and “*minds*” in his work.
6. In his answer, Howard Gardner described intelligences as computational capacities, using the metaphor of a computer. An intelligence is similar to the folk concept of talent. Just as a computer can do many things, intelligences can be put to many tasks, and the performing aspect of an intelligence is called a skill. Later on in the conference, he developed the metaphor further: the intelligence, or computer, is the hardware, and the skills are the software.

7. If there was only a single intelligence, an individual's performance on different sets of tasks would be limited by a single constraining capacity. Maintaining that there are multiple intelligences instead opens up the possibility that performance in a certain area does not predict performance in other areas that involve different intelligences.

8. Computational capacities, or intelligences, are only one aspect of the human mind. While people who are strong in an intelligence are likely to become experts in a certain area, that says nothing about their creativity, which is another faculty of the human mind. Being creative means using your intelligence and your skills in ways to raise new questions, to come up with new methods, to evaluate unexpected results, and that's a totally different stance and set of skills than simply being an expert who is good at doing what other people do. Whether skills are stretched in the direction of being creative depends much more on personality, motivation, and the kind of education milieu in which people grow up, than on their pure intelligence, or pure computational capacity: for instance, it is a killer of creativity to pursue error-free learning, as in the Confucian societies described by Jacqueline J. Goodnow.

### *Creativity*

9. Howard Gardner was then asked to elaborate on the concept of *creativity*: can and should schools help all students progress in creativity?

10. Unlike most psychologists, Howard Gardner has been mostly studying so-called "big C creativity", the creativity of big masters. He explained that this focus was motivated by the feeling that the inventiveness that is assessed by tests of "small c creativity" (in which a typical task would be to ask people to come up with new uses for a paper clip) was not of much use, and was better described as cleverness than as creativity. In his opinion, it is far from clear that there is a connection between this skill and the kind of life-transforming creativity that we admire.

11. Some common traits emerge from the biographies of the universally admired creative masters, such as Igor Stravinsky or Virginia Woolf. These "big C" creative people have usually spent at least 10 years mastering a domain; and they typically aren't characterised by one particular intelligence, but more by an unusual combination of strong intelligences.

12. There are also some lessons that everyone can learn from these "very big C" creative individuals. One lesson is to push what you're good at, rather than worry about things that you're not very good at. Another one is "framing", which means, to use Jean Monnet's words, to "regard every defeat as an opportunity". Highly creative people fail at many things, because they are very ambitious in their undertakings: but when this happens, they pick themselves right up and try something else.

13. In the United States, there is not a great need to inculcate creativity in formal education, because the lessons of creativity are so powerful on the streets – in Hollywood, Silicon Valley, and Wall Street, people constantly try out new things (not always for the best). The more creativity is manifest on the streets, the less you need to pay attention to it in school. In fact, in the United States people may possess the habits of creativity, but often lack the discipline to achieve something new and valuable.

14. Speaking of curriculum, of course, there is no such thing as the "23 steps to creativity" that could easily be translated into a curriculum. Nevertheless, at Project Zero, a curriculum was developed some years ago called "Creative Intelligence for School", with the intention of helping students explore the many ways of responding to an assignment and discuss the pros and cons of each approach, rather than guiding students to the one right answer. As an example, the researchers and teachers took the book report – a common assignment in the United States – because there are many possible ways of writing about a book.

15. But much more influential than the school curriculum is the general attitude towards knowledge that is displayed at home, in the media, on the streets and in school. A sceptical attitude, that systematically argues for a point of view that nobody else defends, is what characterises a liberal arts environment in our best universities, and is very valuable because it broadens the students' repertoire of possible points of view. But there are other attitudes as well that are valuable. Academics are in many respects the opposite of entrepreneurs. Academics are afraid of ever making a mistake; entrepreneurs instead act first, and if what they did proved wrong they try something else. Now, if you want to have an innovative society, to what extent do you want to develop scepticism, as opposed to trial and error? That may require an orchestration of what happens in schools with what happens at home, in the media and on the streets.

16. The important point here is that one needs to think systemically about creativity. And this also means that maybe not all of us should mess around with trying out new things (just as a society needs good followers in order to have effective leaders). Professor Gardner, for instance, as a teacher, confessed that he tries to sprinkle creativity only in students who have a creative spark to start with (the source of which remains unknown): with most students, he just tries to help them do better work.

17. The individuals that have this "creative spark" are not necessarily prodigies. Prodigies are young people who very rapidly acquire the same mastery of a discipline as an adult can have. Prodigies in general become experts. With the exception of Picasso and Mozart, most people that we regard as highly creative were not prodigies: in their childhood, they tended to be perceived as odd, rather than as gifted, although their academic record was ok. The rare creative prodigies had, at some point, to reject the orthodoxy in which they were raised, and that was often impersonated by their fathers. Most highly creative individuals, instead, are not prodigies, and first develop an unusual personality, then search for an area in which they can excel with this personality.

#### *Education for the twenty-first century*

18. Bruno Della-Chiesa then invited Howard Gardner to speculate on the *skills needed in the 21st century* and on the *future of education*.

19. Professor Gardner described himself as deeply troubled by the realisation that many jobs in the developed world are disappearing because they can now be performed by machines or by very poorly paid people in developing countries. For the mass of society, for those who were farmers in the 19th century and factory workers in the 20th century, it is hard to see where they will be employed in the 21st century.

20. On the education side, Howard Gardner defended a shift of focus from facts to methods, and a greater attention to ethical aspects of education in the 21st century. On the one hand, educators should not lose time making people master information, but focus on helping people understand the methods whereby knowledge is asserted and assimilated: the latter has indeed become crucially important in a world in which the informational core of all disciplines is easily accessible to everyone. On the other hand, the way people relate to each other productively and peacefully is number one on the agenda in a highly connected world, and this is why much of Gardner's recent work focused on ethics. In fact, when one looks at the current problems of the United States, they were not caused by students who would have performed badly in the PISA tests, but by "the best and the brightest" who went to the Harvards and Yales and who are often the instigators of the wars and financial crises of the last decades. But when we compare educational systems, our rankings are based on tests of knowledge and disciplines, whereas the rankings that we really need are about which societies get their act together as far as respect and ethics are concerned.

*Questions and answers: ethics, collective creativity, informal education*

21. The *question and answers session* with the audience provided Howard Gardner with the opportunity to develop and clarify his thought on many of the themes that were addressed in the first part: the challenges for schools in the 21st century (and the importance of an education for respect and ethics), the distinction between individual and collective creativity, and the balance between formal and informal learning.

22. In Howard Gardner's view, the United States provides a typical illustration of the diversity of *challenges that education is confronted with in the 21st century*. The United States can be thought as having three different education systems in a single country: the first can be found in inner-cities, with high concentrations of disadvantaged youth; the second is in the heartland, in places that people from Europe rarely visit; and the third is in the wealthy suburbs and other affluent neighbourhoods. If good work can be characterised by a combination of excellence, engagement, and ethics<sup>1</sup>, then each of these systems has different challenges. In the inner cities the problem is excellence: students do not have the literacy skills and the disciplinary skills to be able to get work in the 21st century. In the heartland, the problem is engagement: people know how to read and write and calculate, but they do not care; to caricature, they do not know what is going on in the world and never read a book. With the children of affluent urban and suburban neighbourhoods, the problem is ethics. They are ready to cut corners in order to be rich, famous and successful, and the more the pressure to succeed is high and the funnel is small, the less they think about what they do in ethical terms. This is why Howard Gardner has devoted the recent years to working on the ethical muscle of young people, helping them understand that it is not enough to be clever – the important question is to what use you put your cleverness. One solution is to provide the brilliant student with alternatives to a career in finance or consultancy: Teach for America for instance is trying to address this need.

23. While respect and ethics cannot be quantified in numbers, it is fairly easy to ascertain whether in a school or elsewhere there is an air of respect, or whether a workplace does or does not have an ethical compass. But will we ever have a test of this? Formal measures are too easily converted into checklists which have no meaning anymore, and ethics is not just about compliance, but about meanings.

24. Concerning *individual and collective creativity*, Howard Gardner has so far mostly concentrated on individual creativity: nevertheless, in new work under the good collaboration project, He is starting to address the issue of collective creativity. Collaboration skills are becoming more and more important, especially in frontier research; and clearly there are societies and countries where the collective creative output is greater than what could be predicted from the sum of individual creativities. Finland and Singapore may illustrate this; while being different in so many respects, one common trait between Finland and Singapore is that they are both flat societies, that try through their education systems to level the differences that pre-exist in social capital.

25. Regarding the balance between *formal and informal learning*, Howard Gardner expressed the view that learning occurs in many places and takes many forms, and this should not be constrained: at home, in schools, in after-school programmes (such as the extracurricular activity of writing a high-school newspaper). The most creative and intelligent people rarely have very good things to say about school; they almost always talk about mentors who modelled their behaviours, and sometimes they refer both to mentors and anti-mentors (people who the students could not like and from whom they learned what not to do). All young people need heroes and paragons, and it is sad today that there are so few outside of the family, because we are so good at highlighting the problems with everybody and everything. It may be

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<sup>1</sup> Howard Gardner refers to the “Good work” project. More information can be found on [www.goodworkproject.org/](http://www.goodworkproject.org/) and [www.goodworktoolkit.org/](http://www.goodworktoolkit.org/).

good to know that nobody is perfect, but we should not infer from this that we cannot learn anything from anybody.

26. For young children, the early interventions do not need to be formal in many societies; whereas formal pre-school education is desirable in places where young children have little human and social capital around them, for instance because both parents work. But even when we have formal pre-school, pre-school (or parents at home) should not be doing the job of schools. Childhood is a wonderful gift that should not be taken away by a misplaced pressure to anticipate the school curriculum, which generates frustration with learning among many kids who are not ready for it.

27. After this conversation with Howard Gardner, the conference programme continued with sessions devoted to three specific areas in which CERI's Innovation Strategy for Education and Training undertakes work as part of its education for innovation strand: science and maths education, arts education, and assessment.

### **Session 3: Science, Technology, Engineering and Mathematics (STEM) education in innovation-driven societies**

28. Chaired by David Istance, this session dealt with Science, Technology, Engineering and Mathematics education, which are often expected to prepare people for working in innovation-related occupations. The challenge for schools is not just to train and select brilliant scientists and mathematicians, but to ensure that all pupils acquire the scientific and mathematical literacy and a range of competences, including reasoning, creativity, communication, curiosity, etc., that enable them to contribute to innovation processes later in life. How can curricula, pedagogies and assessments in science and maths ensure that learners are equipped with all the skills needed in innovation-driven societies?

#### *Meta-cognitive mathematics education*

29. In the first presentation of this session, Prof. Zemira Mevarech (Bar-Ilan University, Israel) presented her work in collaboration with Prof. Bracha Kramarski on meta-cognitive mathematics education. Mathematics education ought to develop quantitatively literate citizens, *i.e.* help students use their maths skills beyond the exam answer sheet, in all sorts of problems that they may encounter in life. Yet traditional mathematics education does not train students to solve complex, unfamiliar, non-routine problems that require quantitative and logical skills.

30. In innovation-driven societies, the ability to confront complex, unfamiliar, non-routine (CUN) problems is important. Prof. Mevarech presented several examples of CUN problems: the solution to these kinds of problems requires skills that go beyond mathematical problem-solving skills that are traditionally presented in mathematics textbooks, and include skills in mathematical reasoning, in mathematical creativity and critical thinking, in mathematical communication. Solving CUN problems also requires strong meta-cognitive skills to regulate the steps in the solution. To help students progress from the solution of standard textbook problems to the ability to confront and solve complex, unfamiliar and non-routine problems, these skills need to be trained.

31. The research on meta-cognitive instruction has shown that meta-cognition is best developed when it is explicitly taught, when it is embedded in subject content, and when it is part of interactive learning environments. Professor Mevarech then illustrated these principles, and the benefits of meta-cognitive instruction, in the context of a specific approach called "IMPROVE", which she developed, together with Bracha Kramarski, at the Bar-Ilan School of Education. Improve has been shown to be effective at all levels of education, for advancing traditional achievement measures in maths, but also maths reasoning, motivation, and self-concept, among low-achievers as well as among high-achievers.

There is evidence, moreover, that IMPROVE is similarly effective in science education, at elementary as well as at high school level.

32. While the success of IMPROVE have proved to be scalable, some challenges remain for embedding meta-cognitive instruction into the national curriculum and making it “mainstream”. One challenge relates to the need to train teachers in this new practice, although Professor Mevarech’s own experience as a teacher trainer shows that this can be done effectively. Another obstacle may be that traditional forms of assessment do not encourage the adoption of meta-cognitive instruction (although meta-cognitive instruction is effective on all sorts of problems). The need for meta-cognitive training, however, is only accentuated by the introduction of technology-rich environments in the classroom: students, indeed, find it particularly difficult to regulate their cognitive processes in ICT environments.

*Science education for innovation-driven societies*

33. The second presentation of this session shifted the focus from mathematics to science education. Francesco Avvisati (OECD Directorate for Education) presented ongoing OECD work addressing three questions: How does science education contribute to individual skills for innovation? Does science education in OECD countries foster all skills for innovation? Are certain science pedagogies more effective in that respect?

34. A recent cohort of university graduates has been surveyed five years after graduation by the Reflex and Hegesco surveys, covering 19 European countries. These datasets shed light on the relation between study careers, individual skills, and innovation participation of recent university graduates. A first finding that emerges from these data is that students graduating from science, or science-related majors, are over-represented among the workers involved in product, technology, or knowledge innovation. However, especially when it comes to product or knowledge innovation (as opposed to innovations of technology or tools), the difference with other majors is small. In fact a fair amount of graduates (at least 40%) from all disciplinary backgrounds contributes to innovation.

35. Reflex and Hegesco data imply that what distinguishes innovative graduates – *i.e.* graduates who contribute to innovation in their workplace – from non innovative graduates is not so much their disciplinary background (as is often thought), as the fact that innovative graduates make use of a larger number of (non-disciplinary) skills in their work. The critical skills that distinguish innovators from non-innovators the most are creativity (“come up with new ideas and solutions” and the “willingness to question ideas”), followed by the “ability to present ideas in audience”, “alertness to opportunities”, “ability to coordinate activities”, “analytical thinking”, and the “ability to acquire new knowledge”.

36. To empower students for innovation, therefore, science education must equip them not only with the technical skills (content knowledge and procedural knowledge) that define the discipline, but also with good skills in thinking and creativity, along with the habits of curiosity, perseverance and with collaboration skills. Science, as a subject, offers excellent opportunities for developing many of these skills; but it is not clear that all of these skills are developed in today’s schools. Many high performing countries in terms of PISA science score rank in fact among the lowest in terms of students’ interest in science. Only in few countries do students achieve high science scores with high interest in science. Although the interest scale may not be entirely comparable across countries, a similar finding emerges when one looks at the ranking of schools within countries.

37. It is therefore far from clear that the full spectrum of skills for innovation is fostered in schools today. Yet, only if they are given explicit attention will social and behavioural skills and skills in thinking and creativity thrive. The findings of a new analysis based on the PISA 2006 survey of associations of instructional practices with science scores and interest levels speak to this point: although no instructional



practice is highly correlated with science scores, the use of real-life applications in science teaching has clearly a strong positive correlation with students' interest for science topics. Interest and curiosity are nurtured when the teacher explains how a school science idea can be applied to a number of different phenomena, uses science to help students understand the world outside school, or shows the relevance of school science to society and in students' lives.

*Promoting creativity in physics undergraduates*

38. Professor Frank Kowalski (Colorado School of Mines, United States) presented work carried out with colleagues on how to enhance creativity in an undergraduate physics class. His presentation drew on a project supported by the HP Catalyst Initiative.

39. To enhance creativity requires more than training knowledge and technical skills (such as problem solving, noticing anomalies, etc.). It requires behavioural traits/habits of mind such as being curious, seeking patterns, being persistent; and it requires motivation. How can one train these traits and habits?

40. For some of the traits that characterise creative individuals – such as being curious – the traditional approach of inviting students to ask questions in a classroom setting is not well suited. Evaluation apprehension inhibits student participation. InkSurvey, a web-based software developed at the Colorado School of Mines that is fully integrated with tablet technology, creates a learning environment that is better suited for interactive learning. Students are equipped with networked tablets and can sketch and submit answers to their instructor without the embarrassment of being mistaken (answers can be submitted anonymously). Instructors (or other students) see the responses of all students instantaneously. InkSurvey has already proved to be effective for giving students real-time feedback on traditional problem-solving exercises, where the objective is to improve their mastery of technical skills and knowledge. But InkSurvey is also effective in training traits such as curiosity. When the teachers invites students to ask questions showing their curiosity through InkSurvey, he gets a long list of submissions from the entire class, he can give feedback to guide the students' questioning and invite new submissions, or highlight the best or most original submissions, thereby letting students learn to be curious by observing others' curiosity.

41. Creativity is a cognitive process that involves making new connections and associations between ideas or information. While there are many ways of coming up with new connections (including random association), “useful” creativity requires that these connections are evaluated. So teaching creativity means to teach how to find the diamond in the rough: the one idea that does work out of a bunch of ideas, most of which may not work. This process is similar for individuals and groups. Groups may encourage creativity, because they facilitate the generation of new ideas and of new connections; but groups can also inhibit creativity. In group settings, InkSurvey can enhance the drivers of creativity and overcome some of the obstacles to creativity: it facilitates the sharing of ideas while reducing evaluation apprehension, encourages students to participate and to pay attention to the ideas of others. InkSurvey can assist students both in the idea generation steps (prompting students to practice various techniques for it) and in the idea evaluation steps (inviting students at the appropriate moments to exercise positive critical thinking, negative critical thinking, and to define a metrics for evaluating the final solution), thereby facilitating group creativity.

42. The discussion highlighted some common themes that ran through all of the presentation, such as the need for explicit training of the competences that are desired, or the importance of fostering students' motivation and interest, and the many ways in which this can be done.

#### **Session 4: Arts education in innovation-driven societies**

43. The fourth session discussed the place of arts education in innovation-driven societies, including its impact on students' skills. It was chaired by Stéphan Vincent-Lancrin.

##### *The impact of arts education on skills for innovation*

44. Ellen Winner (Boston College, United States) highlighted the main findings of a forthcoming OECD report on the impact of arts education on skills for innovation.

45. In many countries arts education suffers from budget cuts or from a near-exclusive focus of education policy makers on mathematics, science, and reading. Some people in the arts education community have reacted to this by advocating that educating children in the arts will result in stronger performance on the outcomes that policy makers value (making a transfer argument).

46. There are problems with most of the transfer claims about the benefits of arts education for non-artistic domains. These claims are theoretically weak, because the mechanism that would support such transfer effects is rarely specified. Furthermore, the evidence that is provided in support of these claims is methodologically flawed, because it is in most cases correlational, with very few experimental results to support causal interpretations.

47. The few experimental studies do not support broad, generic claims about the benefits of arts education on non-arts outcomes, but do document some specific impacts. For instance, training in a musical instrument increases IQ by a few points as well as executive functioning (concentration, etc.); looking closely at visual arts strengthens observational skills when viewing scientific images; and drama education strengthens empathy and understanding of others.

48. Most experimental findings are instances of close transfer, for which there is a clear explanation as to why a habit of mind that is trained in the parent domain (the arts) could transfer to a different domain. Surprisingly, there are very few studies that document the development of habits of mind learned within the artistic context. Ellen Winner pointed out that the first step in any transfer research should be to demonstrate learning in the parent domain; the second step is to examine whether such learning transfers. Most of the "transfer" research neglects the first step.

49. Ellen Winner concluded her presentation with a call for greater rigor and realism in the research on the impacts of arts education; and by highlighting the dangers of emphasising instrumental justifications over the intrinsic merits of arts education. To improve results in a transfer domain, direct teaching within that transfer domain will always be more effective than any indirect approach. But if the purpose of education is to teach children about the most important things that humans have invented, these would be the arts and the sciences, and that ought to be sufficient as a justification for arts education in school curricula.

##### *Roundtable discussion*

50. The roundtable participants were then invited to comment on Ellen Winner's presentation and to debate on the role of arts education in innovation-driven societies.

51. Teunis IJdens (Cultuurnetwerk, the Netherlands) welcomed the conclusion that arts educators should not embark in instrumental justifications but focus on improving the quality of arts education and its effectiveness in terms of competences that are directly targeted. Artistic competences can be defined in three ways: a first, narrow, work-related definition refers to human capital for the arts, and for the arts-related parts of the creative industries; a second, broader, but still work-related definition refers to artistic

and aesthetic aspects of work in various domains especially where they involve communication and stylisation; the third, non-work related definition refers to artistic aspects of cultural learning more generally, from early age and life-long, something that makes us who we are and enables us to read the environment in which we live. Arts education in primary school and secondary school is not about creating artists but about stimulating cultural competences in every child and young person.

52. In the Netherlands, primary schools have large autonomy in administering arts education programmes and there is no national curriculum. Nevertheless, all primary schools are legally bound to teach pupils in six domains, one of which is artistic orientation (although the current focus of education policy is very much on three core subjects of reading, writing, and arithmetics, partly because of PISA). The *Act on primary education* states three goals for arts education in primary schools: these are a) to learn to use art forms to express feelings or describe experiences; b) to learn to reflect on one's own and other pupils' work, and c) to acquire some knowledge and appreciation of cultural heritage. The recent cultural policy paper for 2013-2014 ("More than Quality") acknowledges that cultural education stimulates children's creativity and contributes to an inquiring attitude, and encourages efforts to assess the extent to which the core goals of arts education are being attained. With regard to stimulating skills in thinking and creativity, Teunis IJdens stresses that this is a challenge for educational research and development in all subjects, arts education included, and should be part of our efforts to improve the quality of teaching.

53. Laura Cassio (European Commission, Directorate General for Education and Culture) also underlined that artistic competences are intrinsically valuable, as shown at policy level by the fact that "cultural awareness and expression" has been included in 2006 in the list of key competences at European level. Even from a narrow economic perspective, cultural and creative industries account for 4.8% of GDP in Europe and employ 3.8% of the workforce; arts subjects can provide skills for these sectors, but in order for these sectors to thrive the public as well needs to be educated in the arts.

54. A further role of good arts education programmes in schools may be that of improving school attractiveness and thereby reducing the alarming rates of early school leaving. This may not be linked specifically due to the arts form, but rather to the fact that quality programmes that involve artists and professionals act as a catalyser of students' interest and confidence in learning. Programmes such as El Sistema in Venezuela and Creative Partnerships in the United Kingdom have already proved their success. This area deserves further research, and recently, the European Commission has sponsored the DICE project<sup>2</sup> ("Drama Improves Lisbon Key Competences in Education"), a rigorous cross-national effort to evaluate the benefits of theater education which has given very positive results, especially on affective and motivational dimensions.

55. Anne-Marie Boutin (Agence pour la Promotion de la Création Industrielle, France) underlined, in her intervention, that arts education provides an effective platform for overcoming the divide between "manual", "artistic" and "intellectual" skills which is particularly strong in the French education system. The greatest innovators use their minds, their hands and their soul together to achieve something creative. However, manual and artistic skills cannot be taught effectively by the same kind of teachers as intellectual skills.

56. Design – which is not an arts form – has an additional virtue: It enables people to bridge across disciplines and facilitates communication without using language as a tool. This may be the reason why

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<sup>2</sup> <http://www.dramanetwork.eu/>

design is becoming increasingly popular not so much as a subject of education, but as a methodology for education<sup>3</sup>.

57. In her roundtable intervention, Ellen Winner underlined that the benefits of arts education need not be confined to the technical skills involved in the different arts forms or to non-cognitive aspects of learning. In fact, an ethnographic investigation into the habits of mind that are developed in studio arts classrooms (“Studio Thinking” project) found that students were taught faculties such as meta-cognition: they were constantly prompted to evaluate their work, to explain their thought process, and to reflect on the reasons behind their choices, and they developed a language for doing so. Meta-cognition acquired in the arts may or may not transfer to other domains, but it is unfortunate that existing research on transfer has not looked closer at this kind of competence which is stressed in strong arts education programmes.

58. The discussion was then opened to the audience. In the general discussion, a recurring theme was that the wider benefits that are attributed to arts education – such as the development of certain habits of mind, or the development of respect, self-confidence, and enjoyment of learning – are not unique to arts education, but depend on the way a subject is taught. Although arts education at its best may have adopted certain effective pedagogies more readily, nothing prevents other subjects from imitating arts education in this respect. The decision on which subjects to teach is, in the end, mainly a question of values.

#### **Session 5: Assessments for skills in thinking and creativity**

59. The last session was devoted to a discussion of new approaches to assess creativity, critical thinking and authentic problem solving skills in schools. It was moderated by Dirk Van Damme.

60. Guy Claxton and Ellen Spencer (Centre for Real World Learning at the University of Winchester, United Kingdom) opened the session with a presentation of findings from the research project “Progression in Creativity: Developing New Forms of Assessment” (a background paper prepared for the conference is available on the conference website<sup>4</sup>).

61. The aim of the project was to provide a proof of concept for a new tool that, at different grade levels, can be used to track progressions in the attitudes towards uncertainty and novelty that characterise creative minds. This assessment tool was to be useful in mediating formative conversations between students and teachers, and in enabling self-assessment by students. The project decided to focus on creative “habits of mind” (rather than skills) to underline that educating for creativity is not so much about expanding what pupils *can do*, but about cultivating their inclinations and dispositions, and caring about what students *do do*.

62. In the research phase of the project, the relevant habits of mind were selected, named, and described, bearing in mind the need to balance scientific rigor and accuracy with the imperative of developing a helpful and manageable tool for pupils and teachers. Five habits of mind were selected: “imaginative”, “inquisitive”, “persistent”, “collaborative”, and “disciplined”. Each of them was further specified into sub-habits, or described with an exemplar statement.

63. The development phase used two field trials to gather feedback from teachers on the tools’ framework, presentation, language, and uses. Overall, the teachers (all volunteers) felt that the framework was appropriate for assessing habits of mind related to creativity in school contexts, and started to use the tool for discussions about the school curriculum and learning materials. Pupils who trialed the tool

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<sup>3</sup> An interesting example of education through design can be found in the video [www.youtube.com/watch?v=iG2fOO056RA](http://www.youtube.com/watch?v=iG2fOO056RA)

<sup>4</sup> [www.oecd.org/dataoecd/62/29/50153675.pdf](http://www.oecd.org/dataoecd/62/29/50153675.pdf)

naturally learned a new language to describe what they were doing when being creative. This development phase will continue in the coming months, possibly with the involvement of international partners.

64. In the second presentation of this session, Michael Davidson (OECD Directorate for Education) presented new developments in the assessment of problem solving skills in the context of international comparative surveys.

65. When PISA included for the first time, in 2003, a paper-based measure of problem solving skills, problem solving was defined as an individual's ability to use cognitive processes to confront and resolve real, cross-disciplinary situations where the solution path is not immediately obvious and where the literacy domains or curricular areas that might be applicable are not within a single domain of mathematics, science or reading. In PISA 2012 the assessment of problem solving moved to a computer-based test with a revised definition of problem competency as follows: "problem solving competency is an individual's capacity to engage in cognitive processing to understand and resolve problem situations where a method of solution is not immediately obvious. It includes the willingness to engage with such situations in order to achieve one's potential as a constructive and reflective citizen". The assessment does not require ICT skills to master the problems. The move from a paper-based test to a computer-based test corresponds to a move from static to dynamic problems that enable to gauge not just the validity of the solution, but also the students' willingness to engage with problem situations where a method of solution is not immediately obvious. The four components of problem solving competencies that are assessed are: the ability to explore and understand the problem; to represent and formulate a strategy; to plan and execute the solution; to monitor and reflect on the results.

66. A new development will occur in 2015: PISA plans to include a computer-based assessment of collaborative problem solving skills. An early decision was made to measure the individual contribution to a group's success in problem solving, rather than the group's ability to solve problems. The current working definition of collaborative problem-solving defines it as the capacity of an individual to effectively engage in a process whereby two or more agents attempt to solve a problem by sharing the understanding and effort required to come to a solution. The concrete implementation still raises a number of questions, for instance on how the social aspect of collaboration is integrated with the individual problem solving competence in the scoring of collaborative problem solving. Moreover, if students were grouped in teams, the grouping procedure might introduce all sorts of biases in international comparisons (dispositions towards collaboration may depend on prior knowledge of teammates, on social differences, etc.), and the ICT infrastructure requirements might be too heavy for many schools; the PISA board of countries is therefore currently considering the feasibility of student to student collaboration or whether the assessment should assess students collaborating with a computer generated partner(s), with the questions of validity that this raises. Concrete instrument development has yet to start and will certainly prove challenging as well.

67. After the two presentations, the roundtable participants were invited to discuss the development and uses of assessments of skills in thinking and creativity, and the challenges to adopting innovative forms of assessment.

68. Deborah Nusche (OECD Directorate for Education) answered this question based on the preliminary findings from the Education Policy Committee's "Review on Evaluation and Assessment Frameworks" project. She described how many countries have increasingly emphasised, in policy documents, the importance of cross-curricular competences. However, while curricula are now often competence based, assessment systems remain traditional: on the one hand, national standardised assessments still focus on subject-based skills, and this naturally influences what happens in classrooms; on the other hand, national authorities may feel that formative, classroom assessment is the best setting for

assessing these competencies, but teachers lack guidance on how to do so, and the cross-subject nature of competencies further dilutes efforts.

69. It is therefore very helpful to teachers if clear descriptions of criteria for assessment as well as worked out examples are developed. However, because it is not sufficient to have a few isolated experiences of formative assessment, a systematic promotion of these competences requires that national tests (which may take the form of complex ICT assessments, of sample-based assessments, or get inspiration from innovative approaches in the vocational education and training sector) as well as teacher and school evaluations are also aligned with the same objective.

70. David Istance (OECD Directorate for Education) reacted to the presentations and to the question of how to use assessments to promote skills in thinking and creativity with the insights from CERI's "Innovative Learning Environments" project. He stressed the importance of overcoming the gap between what is assessed and what the learning goals are: among the cases that are mapped in the innovative learning environment project, one can find many positive examples of how this can be done with assessments that are built around portfolios, projects, or performances and that are more authentic and engaging than traditional forms of assessment.

71. Formative assessment can be used as a learning strategy in different ways, and providing feedback to the learner is only one of them (and possibly the weakest). Formative assessment can help clarify the understanding of learning goals; it can engineer discussions that elicit evidence on effective learning; it can activate students as resources for peer-learning, and as owners of their own learning. In fact, in the feedback function, the information that goes from the student to the teacher is possibly more important than the information that flows in the opposite way, as illustrated by Frank Kowalski in session 3.

72. Bill Lucas (Centre for Real World Learning at the University of Winchester, United Kingdom) echoed this last point, by describing how the tool for assessing progressions in creativity turned out to be a "Trojan mouse" for cultural change. What was initially thought as an assessment tool encouraged teachers to think about pedagogy, and students to think beyond the classroom.

73. Michael Davidson agreed that formative assessments are often more innovative than summative exercises, but sometimes large-scale assessments such as PISA can also be a driver of cultural change. Many countries, indeed, adopted a competence-based curriculum in part because of the influence of PISA and of the fact that systems are now evaluated in terms of the students' "skills for life". He also expressed some words of caution regarding the influence of assessment on teaching: TALIS shows that traditional teaching practices are prevalent in all countries, and yet not everywhere is the assessment framework rigid and traditional.

### **Additional Material**

39. The conference programme is included in the appendix of this document. Presentation supports and multi-media audio and video files can be found on the OECD website<sup>5</sup>.

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<sup>5</sup> [www.oecd.org/document/15/0,3746,en\\_21571361\\_49995565\\_49798543\\_1\\_1\\_1\\_1,00.html](http://www.oecd.org/document/15/0,3746,en_21571361_49995565_49798543_1_1_1_1,00.html)

**ANNEX: AGENDA**



**Educating for Innovative Societies**  
26 April 2012

OECD Conference Centre Auditorium  
2, rue André Pascal - 75016 Paris

## **Background**

Education and training systems are increasingly under pressure to empower people to innovate and quickly respond to new skills needs generated by innovations. While lack of skills limits the amount and the diffusion of innovation, innovation requires a diverse set of skills that may vary across sectors, organisations and activities. In addition to disciplinary competences, skills such as creativity, critical thinking, and the ability to communicate and work in complex problem-solving teams are vital to innovation.

Consequently, skills and education for innovation form an essential part of the [Innovation Strategy for Education and Training](#) by the OECD Centre for Educational Research and Innovation (CERI). The work on education for innovation brings together research evidence on pedagogies, curricula and assessments that foster different individual skills for innovation. The skills for innovation refer to (1) subject-based skills, (2) skills in thinking and creativity as well as (3) behavioural and social skills.

The OECD conference will discuss the emerging conclusions from this project. Renowned international experts and OECD analysts will present their findings and stimulate lively debates on how Science, Mathematics, and Arts education contribute to the development of skills for innovation; and on how to assess skills in thinking and creativity within school contexts.

Setting the stage for the discussion, Howard Gardner will open the conference and answer questions about what his work on multiple intelligences implies for 21st century education. Active participation of the attendees in the discussions will be encouraged.

## **Objectives**

This one-day conference aims to:

- present the findings of the forthcoming OECD report on arts education's role in developing skills for innovation-driven societies;
- present and discuss evidence and policies in mathematics and science education that can lead to better skills in thinking and creativity;
- present and discuss innovative assessment tools that raise awareness and provide formative and summative feedback on other skills than disciplinary skills.

The working language of the conference will be English.



## Agenda

### **9.30-9.45: Session 1: Opening**

- Dirk Van Damme (OECD)

### **9.45-11.00: Session 2: Conversation with Howard Gardner**

Howard Gardner will talk about the implications of his work on multiple intelligences for 21<sup>st</sup> century education, review the related innovations that it has triggered in terms of curriculum, pedagogy and assessment, and set some new challenges for the decades to come. The session will start with an interview with OECD analysts and leave large place to questions and answers with the audience.

- Howard Gardner (Harvard Graduate School of Education)
- Stéphan Vincent-Lancrin (OECD)
- Bruno Della-Chiesa (OECD)

*11.00-11.30: Coffee break*

### **11.30-13.00: Session 3: STEM education in innovation-driven societies**

Science, Technology, Engineering and Mathematics education are often expected to prepare people for working in innovation-related occupations. The challenge for schools is not just to train and select brilliant scientists and mathematicians, but to ensure that all pupils acquire the scientific literacy and a range of competences, including reasoning, creativity, communication, curiosity, etc., that enable them to contribute to innovation processes later in life. How can curricula, pedagogies and assessments in science and maths ensure that learners are equipped with all the skills needed in innovation-driven societies?

Chair: David Istance (OECD)

- Zemira Mevarech and Bracha Kramarski (Bar-Ilan University, Ramat-Gan):  
*Mathematics education in innovation-driven societies*
- Francesco Avvisati (OECD):  
*Science education for innovation-driven societies*
- Frank Kowalski (Colorado School of Mines):  
*Promoting and assessing creativity and innovation in physics undergraduates*

*13.00-14.30: Lunch break*

### **14.30-16.00: Session 4: Arts education in innovation-driven societies**

A forthcoming OECD report about the role of arts education in fostering skills for innovation will be presented: this report highlights the importance of genuine artistic skills in the creative economy and summarises the evidence on specific transfer effects of arts education to closely related social and behavioural skills, but cautions against overly optimistic views of arts education as a panacea for improving all non-artistic skills in general. The panel discussion will emphasise the implications of this report for policies aiming at strengthening education for innovation.

Chair: Stéphan Vincent-Lancrin (OECD)

- Ellen Winner (Boston College)  
*The impact of arts education: What do we know?*
- Roundtable participants: Teunis IJdens (Cultuurnetwerk, Netherlands); Laura Cassio (European Commission, DG EAC); Anne-Marie Boutin (Agence pour la Promotion de la Création Industrielle), Ellen Winner.

*16.00-16.30: Coffee break*

**16.30-17.45: Session 5: Assessments for skills in thinking and creativity**

If teachers and students are evaluated on traditional paper-and-pencil tests, this can be an obstacle to adopting new teaching practices and may discourage attempts to foster students' out-of-the-box thinking and other valuable skills for innovation. This session will present new approaches to assess creativity, critical thinking and authentic problem solving skills in schools and university, for both formative and summative uses.

Chair: Dirk Van Damme (OECD)

- Bill Lucas, Guy Claxton and Ellen Spencer (Centre for Real-World Learning, University of Winchester):

*Progression in creativity: Developing new forms of assessment*

- Michael Davidson (OECD):

*The PISA assessment of problem solving skills: new developments*

- Roundtable participants: Deborah Nusche (OECD); David Istance (OECD); Bill Lucas; Michael Davidson.

**17.45-18.00: Session 6: Concluding Remarks**

- Dirk Van Damme (OECD)