



BtSM2013



SHORT DESCRIPTIONS AND ABSTRACTS OF SESSIONS



Lembang, 27 to 31 May 2013

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Aldino Adry Baskoro & Avivah Yamani (Langitselatan, Jawa Barat, Indonesia)

Water Rocket Activities

(demonstration and hands-on activities with participants, involving participants in building the water rocket)

Short description: We would like to propose a water rocket hands-on activities session with participants. There are three main components in a water rocket session: the launcher, the nozzle, and the rocket itself. In this session we introduce the launcher and actively involve the participants in building the water rockets and launch their rocket using the available launcher. Participants will experiment with several launch mechanism. We can demonstrate the water rocket using several different launchers as well as various models of the rocket itself.

Abstract: Water rockets provide very exciting opportunities to conduct experiments that involve basic physics concepts and principles, such as rocket design, aerodynamics, pressure, Newton's Laws, etc.

In astronomy, rockets contribute indirectly to obtaining more complete information of celestial objects. On earth, not all wavelengths reach the surface; therefore space telescopes are necessary to help us observe the celestial objects. Space telescopes have been launched into space by rockets. In addition, planetary rover vehicles and satellites were all launched by rockets.

In schools, the principles of rocketry can be learned from water rockets. This activity is very interesting, interactive, and full of fun. Students are directly involved in it. Rocket launchers can be made with materials available around us. Since 2008, I have developed three models of water rocket launchers using materials available in Indonesia. Manuals of the models have been written in Bahasa Indonesia and are available for download from the langitselatan website at <http://langitselatan.com/>.

Below are several videos of our water rocket.:

<http://www.youtube.com/watch?v=KysGDT4-SNg>; <http://www.youtube.com/watch?v=XM5F2IZcZ9k>;
<http://www.youtube.com/watch?v=g3sEAzEpGXQ>; <http://www.youtube.com/watch?v=XQsI3buKCOY>.

Deirdre Kelleghan (Independent artist and amateur astronomer):

Action Sun - Lets bring the Sun to Earth

(active participation action art science workshop)

Short description: Action Sun is an activity in which participants aim to create a solar disc on the ground using simple materials to build two of the sun's atmospheres. Coloured paper, PVA glue, and paint are used to drag a real time view of the sun through 93 Million miles of space and land it before the group. In this action knowledge of the beauty and importance of the sun is imparted via dialogue with the group.

Abstract: Action Sun – lets bring the sun to Earth.

Action Sun is an Art / Science activity for children.

Showing the sun to children / people with a h alpha solar scope is a lengthy process. It is difficult for children / people to comprehend the enormous scale of our nearest star when they are seeing it as a tiny object. I put Action Sun together to bridge that gap to help children of all ages achieve some understanding of the sun in safety.

The outdoor format allows groups of participants to participate in building a very large solar disc which mimics the Photosphere and Chromospheres of the sun, includes sunspots, filaments, and prominences. Action Sun can bring the sun to Earth in real time by taking exact data from the robotic space telescope Solar Dynamics Observatory.

Action Sun can be carried out in full cloud as the data about the sun's status can be sourced online from SDO and others. Ideally the data would be taken from the sun itself via a solar telescope. It's a fun educational creative activity.

The circle diameter would be determined by the size of the group taking part and the area available to them to carry out the task. This is directly on the ground so the diameter is only subject to time, amount of participants, and costs.

During the activity we have short breaks in order for me to explain what we have done and to listen to the groups questions. We discuss what we are going to do next in our efforts to bring the sun to the ground before our feet. Tasks are divided in such a way that all the group are involved. Everyone signs the work and it is put on exhibition with Solar data for more eyes to see and understand what the group has achieved.

Paul Wallace (Appalachian State University)

Mobile Learning and Community Engagement

(interactive workshop related to developing community-based projects involving mobile learning)

Short description: This session will focus on designing mobile learning experiences for the local community. Through service-learning, students design and construct learning activities and media that can be accessed on mobile phones in their communities. Topics include issues of the environment and sustainability, as well as history and geography. This interactive session will focus on best practices for including collaboration with community partners, planning for mobile learning, content development, and technology for developing mobile learning.

Abstract: Mobile learning, using mobile devices such as phones and tablets for formal and informal education, has grown in popularity with the rise in recent years of the capabilities of personal mobile devices. This interactive session will focus on processes and applications used to integrate mobile learning into pedagogy through student projects constructing mobile experiences to benefit the local community.

Through service-learning, students design and construct learning activities and media that can be accessed on mobile phones in their communities. Topics include issues of the environment and sustainability, as well as history and geography. Research studies show that this model of mobile learning pedagogy can greatly assist student in developing essential 21st Century skills, such as research activities, critical thinking, and analysis. These skills are essential to the education of today's learner, to excel in an information-based economy. Within a community based mobile learning experience, not only are knowledge outcomes increased, but also students' attitudes increase toward their local community. Students also exhibit an increased interest in global issues, such as sustainability and global climate change.

In order to experience and understand the capabilities of mobile learning, during the conference a mobile learning application will be available at the Bosscha Observatory campus in Lembang, where conference attendees will be able to access learning materials through applications that run on smartphones and other mobile devices. The interactive session then will provide an opportunity for participants to understand the development and best practices for community-based mobile learning. Topics to be addressed during the session include collaboration with community partners, planning for mobile learning, content development, and technology for developing mobile learning.

Among the technical aspects of designing contemporary mobile learning, this session will provide demonstration and hands-on opportunities for content development using Aurasma for augmented reality and object tagging through QR Codes. In addition, mobile game capabilities and systems for scavenger hunts will be addressed, together with additional elements for engaging the learner through the use of authentic context, narrative, and incorporating multi-media content.

Vidula Mhaskar (Toys from Trash, IUCAA, Pune University, India):

Science through activities

(keynote lecture + demonstration)

Short description: This keynote lecture and demonstration focus on learning science by doing. It is argued that the experience of nature, in the form of seeing, touching, hearing, tasting, smelling; choosing, arranging, putting things together and taking things apart, is a necessary basis for true understanding. It will be demonstrated that valuable experience can result from creative tinkering with materials and objects that at no or very low cost are available in the immediate environment of teachers and students in all countries of the world. Such experience is often more valuable than what can be offered via the use of standard off-the-shelf school laboratory equipment.

Abstract: In the last twenty years there has been a remarkable shift in science teaching. From the passive chalk and talk method science teaching is slowly shifting towards a more active method – *Learning by Doing*. Before children can understand a thing, they need experience: seeing, touching, hearing, tasting, smelling; choosing, arranging, putting things together, taking things apart. Children need to experiment with real things.

Often such “activity” based learning is termed as elitist. Some think this method to be appropriate only for developed countries with an abundance of resources. This is patently untrue. The experience of the Hoshangabad Science Teaching Programme (1972-2002) in India which worked in over 1000 Government Schools demonstrated that science can be learnt in a much deeper and fun way by simple experiments using locally available, low-cost materials.

There is a stereotypical attitude that science experiments can only be done in a laboratory setting using burettes and test-tubes wearing a white coat. This is not true. Children are eternal explorers and are always doing science with stuff that is thrown away and readily available. The truth is that science is a viewpoint – to critically look at the world around us. In most school science laboratories in India, the equipment often lies locked in cupboards. A perceptive observer can see the test tubes covered in a layer of dust. We forget that the most sacred and expensive apparatus is not the hardware and apparatus but the child’s mind.

This lecture-demonstration will show the possibilities of doing creative science using very cost-effective materials. We live in a consumerist society where a lot of junk is thrown every day. Much of this junk can be salvaged and used for designing fun experiments and toys for children. Over 800 low-cost science experiments and toys can be downloaded freely from our website <http://arvindguptatoys.com>.

Benjamin Olshin (University of the Arts, Philadelphia, PA):
Harmonious Interaction: Process, Practice, and a Sustainable Society
(presentation)

Short description: This talk/intervention will look at the Daoist work known as the "Zhuangzi", and see what insights this ancient text has for us in terms of creating a more naturalistic and holistic worldview. This will lead to a discussion of how we might work towards a harmonious and sustainable society drawing from Daoist principles.

Abstract: The "Zhuangzi" is a famous work of Daoism, quite different from the more well-known "Dao De Jing". The "Zhuangzi" is of uncertain authorship and date (ca. 4th century B.C.E.?). The work seems to have been written in a time similar to ours: one of instability, power struggles, and disharmony (a Chinese curse runs: "May you live in interesting times..."). This talk/intervention examines select passages in the "Zhuangzi", and focuses on key issues surrounding the idea of harmony in the "Zhuangzi", e.g., "resolution of the dual" and the "dissolution of (self)consciousness". We will note the difficulty in the actual practice of the kind of harmonious interaction espoused in both Daoism and Buddhism, but also note that this type of interaction it is vital for a sustainable society. Finally, looking at two intriguing passages in the "Zhuangzi", we will see how this profound work gives us two clues as to a possible path towards harmony: "avoiding entanglements" and "looking at the ancients"...

Cameron Richards (University of Technology Malaysia):
An enneagrammatic model of scientific inquiry? A cross-cultural linking of traditional (non-Western) and modern modes of knowledge-building.
(presentation + workshop)

Short description: This paper/presentation will link a number of ideas relevant to the conference. As others have also found the 'enneagram process' provides a powerful and cross-cultural model to encourage new and innovative thinking for (scientific) inquiry and also very practical, hands-on applications. In this way we will explore a wider and cross-cultural view of 'the scientific mind' and its use for constructive learning and knowledge-building.

Abstract: One of the most insightful as well as articulate science writers of the 20th Century suggested that scientific inquiry should be 'imaginative and inspirational in character... adventures of the mind...along uncharted byways of thought' (Peter Medawar, 1990). To appreciate the 'beauty and harmony' of an integrated model of scientific inquiry within local as well as global contexts of relevance this paper argues that Karl Popper's influential dismissal of science in non-Western and traditional societies needs to be not only challenged for its omissions but appropriated within a larger convergent framework. The paper presents a cross-cultural model of scientific inquiry which builds upon 'ancient wisdom' to represent a convergent bridge between not only traditional and modern concepts of knowledge but the related opposition between mere superstition or ideology and the often ugly and disharmonious manifestations of positivistic or mechanistic science. In particular it explores how ancient symbols of knowledge process such as the Middle Eastern Enneagram (especially in terms of its links to the Pythagorean and Socratic foundations of emergent modern thought) and Chinese Pakua represent exemplary bridges between traditional and modern modes of knowledge building which can also provide a basis for recovering a universally relevant sense of 'beauty and harmony' in a new 21st Century globally convergent and sustainable paradigm of science and technology.

Arthur Kok (Philosopher):

Why we need to transform our thinking about science and technology

(lecture + discussion)

Short description: We tend to think that 1) scientific progress means that our understanding of the world, nature and the universe is growing; and 2) technological advancement means to control things better and to do so more efficiently. However, this understanding reduces science and technology to being nothing more than instrumental rationality under the principle of economic growth. In the vein of Kant and Hegel, I will propose a different, more humane way to think about them.

Abstract: I will take Immanuel Kant's aesthetics of beauty as a starting point. In his third major work, *The Critique of Judgment*, the way Kant speaks about 'beauty' can be understood in the following way: the beautiful world is the world, in which human beings recognized themselves. In the beautiful world is a sensible world, but one where nature is not an external force that threatens my existence, but in harmony it. In such a world there is no injustice, and I exist as one with my body. For Kant, this possible harmony between my freedom and my sensual existence is mediated by what he calls 'technique'. 'Technique' is the human ability to transform nature into a place fit for humans; in other words, a place where morality and right exists, and where human dignity is the highest unconditional value. This idea of 'technique' is much broader than our contemporary view on it. For Kant, it is not simply an instrument to control nature, but a way of existing that reconciles the abstract idea of human dignity with the realization of happiness.

From this point of departure onwards, I will show how this idea of 'technique' is further developed by Hegel. For Hegel, famously, the reconciliation of human nature and sensible nature is realized in 'the self-realization of reason in history'. This formulation needs clarification, but basically introduces an idea of progress that not confined to instrumental rationality. This new idea about historical progress encompasses beauty in its absolute shape: the human being itself is the essence of beauty. The task of philosophy is to think through the idea of humanity in its all encompassing meaning. My goal is to reconnect these, in my opinion, sublime thoughts that life should be all about becoming human with the everyday praxis, i.e. technique, which is ever more politically instrumentalized and professionalized. Last but not least, this new way of thinking about science and technology will also finally bring together two words, which are often used together, but still differ a lot conceptually: sustainable innovation.

Jan Visser (Learning Development Institute)

Building the Scientific Mind: Reflections (some of them personal) and questions

(talk + discussion)

Short description: The idea to prioritize the building of the scientific mind as a focal area of concern for the Learning Development Institute (LDI) first emerged in 1999 during a UNESCO/LDI symposium on 'Overcoming the Underdevelopment of Learning' held in Montreal, Canada. With a view to collective thinking about the future of LDI's work, I review the history of BtSM and raise questions about 'what next.' Should BtSM continue and, if so, how, or should it, like other past work we engaged in, become a more integrated concern in a larger conceptual framework, about which I have at least one idea. In passing, I will refer to what drove me as well as others to find BtSM an important idea, and how it relates to the thematic issues of BtSM2013: beauty and harmony.

Abstract: The idea of BtSM dates back to 1999, when it emerged during a symposium on '*Overcoming the Underdevelopment of Learning*.' It precedes other concerns that initially captured the attention of the Learning Development Institute, such as the '*Meaning of Learning*' (MOL) and the '*Book of Problems (or what we don't know about learning)*' (BOP). Nonetheless, MOL and then BOP were the first primary focal areas of activity for LDI during the first half of the past decade. Work on BtSM started in earnest only in 2004 with the preparation of the first BtSM colloquium, which took place in 2005. As recommended by the governing board, it has since been LDI's core business. BtSM turned out to be a generative concept that helped inspire thinking about all the various other focal issues, such as MOL and BOP, but also Learning to Learn and Think (LLT); Problem-Oriented Learning (POL); Attitudinal and Behavioral Change (ABC)—particularly as it relates to health issues; and Learning to Live in Harmony (LLH).

My own fascination with the scientific mind is no doubt strongly connected with my former life as a theoretical physicist. Nonetheless, when I first suggested that the scientific mind was worthy of attention from the perspective of the development of human learning, it was immediately clear to me that the scientific mind should not be equated with the mind of the scientist. It was also clear that, to the extent that the mind of the scientist is of relevance to the scientific mind in general, the study of its features should not be restricted to the ways of being and thinking of physicists, chemists, biologists and the like. The scientific mind is equally at work in those whose objects of inquiry pertain to the realm of social and human phenomena and those who, through different forms of art, give expression to achievements of the mind that cannot be expressed in plain discourse or mathematical descriptions.

The scientific mind derives from the millennia long human endeavor to get to know the world; to capture it in ideas (often ideas that are in themselves an expression of fascinating beauty); and to take consciously, and in an ecologically sound manner, part in the evolution of that world. During my talk I hope to clarify my own thinking about what the scientific mind entails, and why it is important to pay attention to its development among the members of our species. In the interest of stimulating further thinking and debate, I shall also draw tentative conclusions about what building the scientific mind implies for rethinking and reforming the human learning environment in today's world.

Finally, I should like to look ahead and ask questions about the way forward. After a decade of an almost continuous focus on BtSM, it becomes time to raise the 'what next' question.

See also the concept paper by Jan Visser on *The Scientific Mind in Context* at <http://www.learndev.org/dl/TSM-ConceptPaper.pdf>.

Weilin Han (3T n 4C)

Unity in Diversity - Put Theory into Practice

(sharing experience)

Short description: When we talk about “Scientific Mind” it is as if when we learn Civics we put the scientific thinking process aside and it is sufficient when we use good beautiful normative words and phrases. We just come up with long blabbery sentences to memorize and recall without even thinking whether we can or want to implement it ourselves. As a result, it is no wonder Indonesia is famous for big religious adherents and at the same time the country has an ugly record of corruption and a low human development index. Assaults towards religious/ethnic minorities are ignored and even tolerated, public school policies and practices encourage and endorse bigger gaps. The proposer will share some experience in teaching ideology for university students (which is compulsory) as well as social sciences for elementary students.

Abstract: In all nations civics is considered as an important subject because it teaches why a nation is formed, how the nation keeps the vision and how the citizens become the adherents of “civic religions”. In Indonesia, civics obtains a huge portion; it is a compulsory subject for twelve years and a half, from grade one elementary to semester one in university. About thirty years ago the government made it a mandatory requirement for civil service, academicians, members of parliament and other official institution leaders to take a hundred-hour intensive course called *Pedoman Penghayatan dan Pengamalan Pancasila* or P4 (Guide to the Realization and Application of Pancasila). Sophomores should take a forty-hour P4 on top of another subject called “*Wawasan Nusantara*” (Archipelagic Concept).

Unfortunately, a subject that is considered as highly important is not supported by constructive teaching methods that nurture inquiry and critical thinking. Values are taught, learned and assessed by way of drilling. Good grades means being able to present normative answers. Besides, almost all education stakeholders (school/university leaders, lecturers and parents) do not consider a student as excellent when he is a Pancasila adherent and a civics literate. They attribute greater respect to a student who excels in “core subjects” such as business, math and science, or something that will guarantee the student a good job.

For the last several years the presenter intentionally teaches Civics to university students and trains teachers in social science, which intersects with civics. The presenter believes that when we consider something as highly important, we will put our utmost effort in making it meaningful. The same holds true for civics. Teaching civics is like getting followers to one’s belief system. The students will become followers even after the course is over when we translate theory into best practices. And when we relate to how the brain works, we keep what we learn in our long term memory when we can associate the subject to contextual and relevant issues. Students will learn best when civics is learned in a constructive approach. Discussion and personal reflection get a major portion of attention in class as compared to rote learning.

Both learners (students and trainees) usually face difficulty in the beginning of the course because they are not used to “think” and ponder on “why” and “why not.” In some areas, the challenge is bigger because of gender, ethnicity and belief issues. “Unity in Diversity” takes longer time to immerse into real value and common platform. However, when the habit of inquiry, asking intelligently, expressing what lingers in their mind (thinking out loud) are nurtured, they will find civics to be part of their lives. By that time, the baton has been handed over. The students and trainees will take the initiative to be the ideology adherents.

Luiza Alonso (Catholic University of Brasilia):
Smart applications of Technology of Information for a Smarter Society
(presentation + discussion)

Short description: Development of open and smart experimental platforms to increase the quality of life experience, citizen participation, inclusion, and sustainable way of life. Major challenge is to explore "mash up" processes of data that synthesize new information in the gathering, connecting, reusing, combining and aggregating semantically disjoint data extracted from numerous sources. Platforms will help in the building of critical mass to strengthening a democratic society where the beauty of being free and responsible will be reality.

Abstract: The Internet and digital media are transforming and expanding the area of social movements. The analysis of the dynamics and interdependence between the dimensions of information, communication and social change have been given place to a new form of social organization in which the production of information, its processing and transmission become the main sources of productivity and power due to emerging technological opportunities. Such opportunities and communication models may be moderated by social collaborative tools and mobile channels referenced, which have information on services, products, policies and joint artistic manifestations. The tools and information and communication technology (ICT) need to be appropriate for the context in order to promote transformative actions followed by attitudinal changes based on new paradigms of information, knowledge, and collaborative technologies social networks.

IT can play a significant role in social issues, once they have the potential to increase income generation, promote welfare, sustainable development, and allow the dialogue between social organizations, government, national forums, management councils and participatory planning in proactive convergence of development actions.

Two projects had been developed addressing such concerns. The "Guardians of the Parks", which main goal is to encourage active participation of young people and adolescents in the production of digital media objects, such as digital photos, relating to national parks and their surroundings, on a basis of building a collection of locative media, with the support of social networks and digital libraries. The project works for the enhancement of artistic, cultural and cognitive skills and competencies among youth and adolescents.

The project develops educational activities to improve more interactivity within the communities and the officials of the Park. The purpose is to identify opportunities for coping with emphasis on the use of ICT, in an empowering social action to preserve archaeological parks and the communities around it.

This is the "Observatory of Social Control" for an environment of concentration, analysis and dissemination of data, information and knowledge on the Brazilian Public Administration focused on the promotion and strengthening of Social Control.

This is an initiative that seeks multidisciplinary convergence of research efforts in the areas of Information Technology (IT), Knowledge Management, Communication and Social Sciences ultimately materialized in computer applications accessible throughout society through the internet, digital TV and mobile. In these applications the average citizen, researchers and social movement's members, will monitor the functioning of public administration, the role of politicians and managers, know the reality of the country through relevant indicators, learn about the functioning of the administrative machinery, and formulate arguments to denounce and protest against abuses, irregularities and mismanagement.

Both projects have been developed through the Popular Education Methodology, that is based on a teaching program rooted in the progress of science that encourages the participation of all in productive work, relates theory to practice, develops human beings in all aspects (mind, soul, body and spirit), and contributes to bring up the fundamental interests of the citizens.

Evgeny Patarakin, & Vasiliy Burov (WikiVote!)

Way to Harmony: Co-editing the Future

(presentation, sharing of experience)

Short description: This presentation will be devoted to changing practices from the individual descriptions of the objects of present and past now to the collaborative construction of the future links later. This will lead to a discussion of how we might design tools and environments that will support collaborative editing of documents that govern our future.

Abstract: Designing new tools is the most effective way to influence people's behavior. We believe that society is changing towards more open and direct participation of people in development and an adjustment of the rules that govern our present and our immediate future. People need tools that will support and enhance their participation in the formation of such rules - in professional regulations (professional standards), in the area of legislative acts (law-making), in developing joint concepts of the future (foresights). Design tools that support the massive creation and editing of professional standards, laws and foresights, will make our future more "co-created and co-edited" and therefore be more harmonious.

James Lees (University of the Western Cape)

The Pedagogy of HIV: Beauty, Truth and the Road to Harmony in South Africa

(uninterrupted, completely interactive, two-hour session that requires each participant to feel and to engage in the journey, followed by 30 minutes of discussion)

Required: projection equipment and a good sound system for music videos.

Short description: This session is an innovative approach to HIV education in a nation still struggling with the personal and social wounds of a violent past. It challenges the status quo of education and of HIV response through a very personal emotional journey guided by seven music videos.

Abstract: The dominant story of HIV has changed little in the three decades of the epidemic. Public Health discourses continue to disguise HIV training as educational endeavours while theories of teaching and learning remain counter posed to the way HIV is addressed in most South African schools. Emotion, a key ingredient of successful learning, has been improperly used with the result of young and old people distancing themselves from the disease, its effects and, concomitantly, its prevention and treatment. Meanwhile, the epidemic carries on with 1,000 new infections and 1,000 deaths each day and is itself a powerful expression of the personal and social disharmonies that have yet to be healed in the New South Africa. This experiential 'lecture' uses the beauty of music to access participant's emotional beings as it challenges everyone present to re-think and re-feel HIV, themselves, the epidemic and their relationship to it. Emotion itself has a troubled history in a land where a long history of violent trauma has wounded some people's ability to feel. It undermined empathy in many – a key necessity for any society to successfully address the challenge of HIV. South African university students and community members who have experienced the session report feeling changed in how they see and feel about themselves and how they see their own ways forward in post-trauma society still grappling with multiple challenges to being.

Martin Gardiner (Brown University)
Music, creation, harmony, beauty and learning
(talk followed by discussion)

Short description: There is growing evidence that music skill learning exercises and helps develop ways of using the mind of great value beyond their value to music alone. Here I add discussion of impact of music skill learning on skills at creation, and in particular, creation that involves harmony and beauty. Relationships to creation, harmony and beauty are central to why we love music, and also to its broader human potential.

Abstract: This talk and associated workshop proposes to continue the development of two interrelated themes which I have been exploring throughout my career, and most intensively in the last two decades. First, human development of music has more to tell us about ourselves than is yet widely acknowledged. Music has the potential to add further detail to our understanding of ourselves. Second, learning musical skill can affect us and in particular, affect our development of mental skill more deeply than is yet fully understood. Since music is widely loved and musical skill widely admired, there are potentially valuable practical implications of connections between musical and broader skill learning.

What accounts for the largely consistent human development of music throughout human history (Gardiner, 2003)? Not, I propose (2008), brain evolution specific to music. Rather, I will review my view of music as an especially fine example of evolved human inventiveness and mental adaptability that allowed us to exploit in a new way critical improvements in how we use our brain we evolved to support mental skill and learning that was central to our survival. Music, then, is seen as building on and helping to window and better understand very essential human capabilities. This view of music is supported by evidence of interconnections between musical and other types of mental skill learning that my colleagues and I (Gardiner et al, 1996; Gardiner, 2000, 2003, 2008, 2010a,b,c, 2012, 2013) and others have been exploring and documenting.

For example, the boost to learning of math arithmetic operations of addition and subtraction that relate to movement up and down the counting number sequence can be related to mental skill learning involving pitch and melody involving movement up and down the note sequences of the musical scale (Gardiner et al, 1996; Gardiner, 2000, 2008, 2010). Similarities in hierarchical structures of verbal and musical language can help to account for connections between skill learning in these skill domains (Gardiner, 2013). The extent to which musical experiences (Dewey, 1932) can induce and interact with emotion in ways similar to other aspects of human experience can help to explain the rich connections between music and emotion so central to its appeal (Gardiner, 2012).

I will now discuss some further examples connecting musical and broader skill learning. First, I will discuss an implication of a consistent observation in our and related research to date. Taking pleasure at listening to music is a necessary but not sufficient condition for developing broader connections between musical and other skill learning. To develop useful interactions between musical and other skill learning, the learner must also develop skills at actually producing music. I argue that the creational nature of musical acts is at the heart of this observation, and also central to the connections between musical and broader skill learning in the brain.

Music's use of harmony will then be discussed. Musical creations deeply exploit harmony both in more narrow and more general senses. Musical movements involving harmony are central to musical language. I will discuss broader implications of this observation for the use of harmony more generally in relation to mental skill.

Beauty will then be discussed as related to harmony but not identical to it. Here again our awareness of and attraction to beauty is important to the appeal of music and also to the broader impact it can have on us.

Martin de Wit (Stellenbosch University)
Economics, Beauty and Harmony
(presentation with discussion)

Short description: The field of economics is not primarily concerned with the concepts beauty and harmony. Economic theories on production, consumption, redistribution and sustainability all provide various explanations for human pursuit towards happiness, but the concept of beauty does not comfortably fit into these schemes. This begs a reassessment of a central philosophical concept that has traditionally been counted as one of the ultimate values in the field of economics. The promise the idea of beauty brings of greater awareness in a simultaneously wonderful and broken world is enticing to economic science that finds itself increasingly out of touch with reality.

Abstract: It seems as if human beings do prefer beauty above ugliness, harmony above disharmony. In economic culture, however, which can be typified as an emergent expression of our collective choice, beauty and harmony are not seen as primary outcomes. Even in more normative schools of thought beauty is seen at best as an intermediate quality in achieving life satisfaction or human happiness.

This raises several questions on how economics, beauty and harmony relate:

- How does economics relate to beauty and harmony?
- What are the focus areas of such relationships?
- Can these focus areas be explained from within economics thinking?
- What is the meaning of the results from economic thinking on these focus areas?
- What values are assumed in taking an economic view on the topics of beauty and harmony?
- Do such value choices have consequences for humans and the earth we live on?
- What are the implications of this analysis on our cognitive reflection on the scientific mind?

This contribution provides a reflection on these questions. We approach the question from what is actually *done* in the economic sciences, using an analysis of search terms in Google Scholar and Scopus. The relationships between human beauty and economic outcomes and between biophysical beauty and increased economic welfare are discussed and the instrumental focus of economic sciences highlighted. Reasons are sought for this state of affairs in a discussion of the philosophical underpinning of economic sciences. The paper concludes with a reflection on what the consequences may be for economic culture and humankind's ability to make wise decisions on utilising nature.

Paul Cobben (Tilburg University)
Marx's Capital: Imbalance of values
(lecture + discussion)

Short description: Although Marx is known as a critic of bourgeois thinking, he strives after an ideal which is completely classical. Finally, he is, like Aristotle, interested in the unity of the true, the good and the beauty. This unity is an absolute one and is thematized in philosophy as the problem of the true substance. According to Marx, the true substance has to be conceived as the ideal society.

In the Capital, Marx analyses the capitalist society as an alienated one, i.e. as a society in which the untrue substance becomes valid. The untrue substance is capital, a social order in which not the human being, but rather money has become the central actor. Because this untrue substance manifests itself immediately as the commodity, the Capital is the systematic development of the commodity into the concrete totality of capitalism.

The lecture exposes how Marx's analysis of the commodity reveals capitalism as a society in which values are fundamentally in imbalance. The commodity has a duplicity in which capitalism's inability is reflected to balance the true and the good. In the duplicity of the commodity the conflict between autonomy and heteronomy is expressed. The critics of capitalism must show how the balance can be repaired. Therefore, Marx's project is in the tradition of Kant and Hegel.

Abstract:

Outline:

- For Marx the human being is a free being. In his freedom, however, he does not oppose nature. The human being is as free being at the same time a natural being. This especially means that he has an openness to the beauty of nature
- Criterion for beauty: the extent to which some-thing has a self, is a substance
- The ideal work of art: the sustainable society (or the substantial society)
- The ideal (sustainable) society was conceptualized by Aristotle as "good life", the unity of the true, the good and the beauty
- For Marx (and Hegel) the ideal (sustainable/ substantial) society cannot be separated from modern freedom: the freedom and equality of the French Revolution. Modern freedom presupposes that the individual is educated to freedom.
- Marx identifies the process of education with the development of division of labor. In the capitalist society the highest stage of labor division has been reached: the division between manual labor and intellectual labor.
- The capitalist market seems to exemplify the free relation to nature: the relation of the free persons to the commodities of the market
- Marx analyses the relation person/commodity from two points of view: the point of view of the market and the point of view of the production
- From the viewpoint of the market freedom appears as "abstract labor": the pretended openness to the natural things is rather the repression of the natural qualities of the thing. Exchange value (money) opposes the qualities of nature
- From the viewpoint of the production abstract labor appears as manual labor which opposes the intellectual labor which is objectified in the production apparatus
- Therefore, the autonomy of the capitalist market is revealed as heteronomy, the mechanical force of manual labor, which opposes the intellectual labor which is objectified in the production apparatus
- Fundamentally the separation between manual and intellectual labor in capitalism is the presupposition of a free relation to nature. Intellectual labor has required insight into nature (the presupposition of the true), but only appears in its objectified form; in the manual labor the human being is reduced to a thing (violation of the categorical imperative: the good). Overcoming the separation between manual and intellectual labor will realize real freedom and an aesthetic relation to nature

Although Marx's rejection of the free market is out-dated, he has formulated the criteria for a non-alienated society: the unification of manual and intellectual labor cannot one-sidedly be realized at the free market. Only when the free market presupposes a domain in which the good life is institutionalized (but, in contrast to Aristotle, mediated by the free market) freedom is not an abstraction from the determinations of nature (and, therefore, an alienated freedom), but a positive relation to nature: the aesthetic relation to a "second nature".

Binta Moustapha, Isah Aliyu Agaie, Bachir Moustapha, Zsolt Lipcsey (B'da Best Concepts)
The splendour of nature and the beauty of science: Motivating Nigerian girls for science, technology, engineering and mathematics.
(report; sharing of experience)

Short description: A short report on the three years activity (2010-2013) of B'da Best Concepts designed to motivate Nigerian Girls on the splendour of nature and the beauty of science.

Abstract: At age 16 and in the final year of my high school, I was intrigued at the beauty of science and the splendor of nature when, as the President of the Junior Engineering Technology and Scientists Club (JETS) of my school, I lead a pack of girls, under the supervision of my chemistry teacher Mr. B.I. Abdullahi, to present an exhibition on the local methods of purifying water, which at the end of the event won the competition at the state level. That event in 1996 kindled an interest in me to pursue a career in science and motivate others to tow the same line.

After my tertiary education I was appointed as a basic science teacher on completion of my tertiary education. It was in the course of my teaching career that I observed the abstraction with which science, technology and mathematical (STEM) subjects were being taught in my country, Nigeria, discouraged students from pursuing careers in Science, Technology and Mathematics (STEM) based courses. Several data and research done on the problems of science education also confirmed this observation notable amongst which is the one published by the World Bank in 2003. It stated that "the African continent has 83 scientists and engineers per (1) million compared to 223 per million in North America, 540 in other developed Countries, 783 in Asia and just 12 scientists per (1) million persons in Nigeria."

Therefore, in response to the clarion call during Nigeria's 50th independence anniversary, B'da Best Concepts was established with the primary objective of rekindling the interest of young girls in mathematics, science and technology. The team is made up of competent resource persons who are committed to developing the interest of the girl child in STEM using science fairs, exhibitions, summer camps, career fairs, educational tours and excursions as means of attaining its set objectives.

Thank you for your attention, I look forward to your audience during the presentation.

Paul Webb (Nelson Mandela Metropolitan University)

Scientific literacy, beautiful arts, and the harmonious transfer of learning

(short presentation followed by discussion)

Short description: Generally there has been very little support in the psychological literature for transfer of learning but recent studies on short term memory and music education, as well as the findings of a number of South African studies on promoting scientific literacy, suggest that transfer does take place. It seems that what is now required is further research into which cognitive activities act on one another to produce beneficial effects, how they interact, and how they can be explained.

Abstract: Generally there has been very little support in the psychological literature for transfer of learning. However, Jaeggi, et al. (2008) and Gardiner (2000) suggest that transfer does take place and the findings of a number of South African studies on promoting scientific literacy also suggest that transfer of learning may take place when using certain approaches to learning science.

Gardiner (2000), while shying away from explicitly attributing it to transfer, has related learning music with improved achievement in mathematics, and Jaeggi, Buschkuhl, Jonides and Perrig (2008) explicitly allude to transfer of learning when using working memory exercises to unrelated problem solving (Raven's test scores). Examples which may also be possibly attributed to transfer from using literacy-based science education strategies to general literacy and numeracy (Amaral, Garrison & Klentschy, 2002; Cervetti, Pearson, Bravo & Barber, 2006; Romance & Vitale, 2006; Sepeng, 2011; Webb & Mayaba, 2008) and generic problem solving as evidenced by scores on Raven's tests (Mercer, et al., 1999; Villanueva, 2010; Webb, 2010; Webb & Treagust, 2006). There are also studies which indicate that no transfer takes place. As such, questions of interest are - what activities and conditions do promote transfer? What does this mean in terms of cognition and learning? What are the relationships we need to consider? How do we explain them? and how do we maximize them?

Attempts to explain cross disciplinary (domain) learning have been made in terms of working memory (Jaeggi, et al., 2008) and mental stretching via music (Gardiner, 2000). It seems that what is now required in terms of science education is further research into which cognitive activities act on one another harmoniously to produce beneficial effects, how they interact, and how they can be explained.

Possibilities are research studies which include:

- (i) Aspects already highlighted in the science education literature such as exploratory talk, argumentation, reading, writing, doing inquiry, etc.
- (ii) Further examination of the effects of using multiple representations, differing modalities, spatial visualization techniques, technology, etc., across domains.
- (iii) Interrogation of the effects on science learning (and vice versa) of arts based activities such as learning music, participating in drama, drawing, and other previously unexamined areas where harmonious cognitive relationships may be mooted,.

It is possible that such investigations could generate harmonious, well-argued and supported explanations of the interrelatedness of science and beauty which will assist the design and planning of better curricula and science related activities. In doing so we may be able to more successfully stretch our learners' intelligences, both crystallized and fluid.

Lê Nguyễn Hoàng (Science for All):
The Importance of Popular Science
(short presentation + discussion)

Short description: A major driving force of researchers in science is their passion for what they're working on. Similarly, for the development of science and the construction of the scientific mind, I believe that it is crucial that people learn science, not because it will provide them diplomas to obtain better jobs, but because they enjoy it. In this activity, I plan on stressing the crucial role of science popularization and debating on how to encourage it.

Abstract: Science and mathematics are nowadays too often associated with complex formulas and difficult exams. Because of this, many students, even great ones, eventually turn their back once they are done with schools. I believe that this represents an enormous loss for societies for the following reasons.

First, this phenomenon affects the image of science. Too often, the phrase "I never understood mathematics" is said without any regret, as if mathematics were some useless topic which only concerns a few mathematicians. Instead, if parents discussed some of the numerous great ideas of mathematics along with the latest Hollywood blockbuster, children could be made much more passionate by science. This passion would help them as they struggle much more to understand mathematical concepts.

Second, periods of crisis like the current one lead politicians to suggest cuts in scientific fundings. Yet, such cuts would be a huge setback to science, which is the main driving force of innovation and economics. To avoid these cuts, it is crucial for science to be much better communicated and to have people changing their image of science.

Third, as research becomes more and more diverse and specified, fields of science become more and more matters of experts. This means that articles are quite often unreadable by non-experts. This is a huge hurdle to the development of science which requires interdisciplinarity. Interdisciplinarity demands a partial but overall understanding of each field involved, which can only be achieved through popular science.

In this activity, I plan on stressing even more these reasons why popular science has to be improved. As well, I want to talk about what I'm doing as a popular science blogger on www.Science4All.org, and how to incentivize people to start writing popular science.

Hala Osman (independent researcher)
Incidental Learning: The Story of Cairo's Graffiti Scene
(presentation + discussion)

Short description: To be provided

Abstract: Following the Egyptian revolution in January of 2011, people's sense and use of public spaces expanded in different ways, especially when it came to art and expression. Artists much like protestors, burst out into the streets to engage people in a conversation of many dimensions with the material they articulated and continue to articulate publicly. The street proved to be 'as public as public gets' and the level of expression found in the street was unprecedented when compared to other spaces. Graffiti continues to grow, more walls are being covered with murals and stencil prints, more names appear here and there signaling the presence of a new artist and with it transforming the streets of Cairo and other Egyptian cities into animated environments of communication and, along with that, making them wider spaces for learning.

Incidental education or learning in contemporary society takes on a different form than that in the village or the "medieval town" according to Ivan Illich (Deschooling Society. 2002. London; Maryon Boyars: p.22) The difference lies in the distinction that in the 'medieval town' education was unplanned and lifelong whereas in a modern society it is planned and isolated in the modern classroom, operating in the same way that other 'specialized' institutions in society function. The revival of incidental learning means that "we must find more ways to learn and teach: the educational quality of all institutions (which) must increase again." (2002: p.23) Although a more holistic approach to learning, Illich recognizes that it is at the same time a threat to the autonomy of the individual because of the possibility of it becoming a full-time method of instruction and manipulation by competing forces trying to take over minds leaving no room for "critical independence." However, the optimism for the idea lies in the possibility moving away from a society that functions on values; and devalues education on the basis of "certificates" where individuals "gain courage to 'talk back' and thereby control and instruct the institutions in which they participate." (2002: p.23) Illich proposes that "Effective participation in the politics of a street, a workplace, the library, a news program, or a hospital is therefore the best measuring stick to evaluate their level as educational institutions." (2002: p.23) This latter point is what Egyptian streets have been witnessing since the outset of the revolution in 2011. Since the end of 2011 I have been tracking graffiti in Cairo and recently also in Alexandria in an attempt to follow and make sense of the changes in the general consciousness and imagination of Egyptians. Street walls offer an insight into the latter as they have gradually transformed into platforms of communication that are a part of an alternative media that was born out of a moment when 'talking back' was recognized as an essential tool to engage with the society at large.

Marten de Vries, & Jaap Swart (Mind Venture International)

Reaching Many: Social harmony and media, co-creating the scientific mind in the public domain

(talk + discussion)

Short description: If the scientific mind is to be an asset for future social development, the use of interactive media communication and the arts will be essential to achieve such a “co-creation” between scientific rationality and pre-existing, grass roots knowledge in a facilitory context of social harmony. We aim to discuss the contribution media can make (or not) in achieving beauty, social harmony in the service of the public’s scientific mind using MVI media concepts and social productions.

Abstract: Is the scientific mind an essential component for future social development? We propose that to achieve *a public scientific mind set, the use of interactive media communication and the arts will be essential in order to reach larger segments of the public.* The scientific mind at best would be a “co-creation” between scientific rationality and pre-existing, grass roots knowledge and cultural experience. A prerequisite for this process is social harmony, particularly at a time of high social liquidity, where social engagement is increasingly relevant for understanding and ordering the constant stream of new information and stress of inter-cultural contact.

MVI builds on mental health and psycho-social science and employs attractive, engaging media arts and products (beauty?) in order to capture the essence of what a population is faced with or concerned about. It is an effort to “co-create” the conditions where people can find each other, discuss and act on issues and feelings important to them. We postulate from data and support it with experience, belief and trust, that if people communicate about shared issues in an ongoing community setting, that such a social discourse will lead, not only to proven outcomes such as feelings of support, pro-active self-confidence and less mental health problems, but also to social cohesion and social harmony. Social harmony leads to the freeing of the mind and improved well-being: a precondition, not only for the scientific mind, but also for social and individual action as well as perhaps the experience of beauty. Our exploration involves the forging of an alliance between media, science and people in the service of the facilitating condition of social harmony.

We therefore propose that science, in our case, (mental/neuro-health and social science) and technology (mixed-media) have a profound role to play in creating social harmony and wellbeing through the mechanism of producing “beauty” or attractive media that facilitates existential and social reflection. A managed form of media linked to “bottom-up” experience can be a place where people re-find themselves and interact, a place where security not anxiety is fostered, a place of both renewable resources and grounded in sustained references to the past. Formats that link grass-roots information to new information, facilitates knowledge building, decreasing anxiety and apathy while stimulating secure social interactions, the basis of sustainability mind sets.

Our presentation explores the contribution media can make (or not) in achieving beauty, social harmony in service of the public’s scientific mind using MVI media concepts and social productions.

Narumon Rodniam (Institute of Physical Education, Chumphon Campus)
'Out of Thinking': The art of seeing the truth for promoting the scientific mind
(presentation, sharing of experience)

Short description: An obstacle of learning development is bias or prejudice, which occurs because we normally use our thinking based on previous knowledge and experiences in our memory for perceiving what we are seeing. As a result, our perception on the fact becomes biased, and our learning development is limited. This talk presents findings from applying the principle of mindfulness and a technique called "Reset to Setting" according to teachings of Buddhism as obtained from a training program.

Abstract: These days, 'scientific mind' is recognized as an important property of a human being required for one's learning development in the 21st century. My friends and I in the Geemanom group (also known as the Reset to Setting group) are members of the learning group that came across each other by chance, but that was not totally accidentally. We, who were from various professions, met each other because each of us had a purpose to develop one's learning and to solve one's problems. We have been cordially guided and advised for our continually developed learning by Master Paiboon Thitadhammo. Gradually and incrementally, Master Paiboon helps us adapt Buddhist teachings as guidelines for our learning development and for the prosperity of our living.

Principle Getting out of thinking and seeing things as they are is a technique to achieve mindfulness by trying to be at present all the time by sensing one's body. A recommended approach is to observe a certain part in our body where we can sense most clearly. This approach should be practiced frequently in order to be skilled and see continuity of the mindfulness. In addition, for keeping our mind at a normal state, we use a technique called "Reset to Setting". That means whenever our mind falls anywhere, whether it falls into a good thought or a bad thought, we should be hurry in leaving that thought. It may be acceptable to let the mind stay in a good thought for some time. However, in case of being in a bad thought, we should get the mind out of that thought as quick as possible.

Operation Our learning process was operated by containing both theoretical and practical sections. The operation of learning was conducted in an informal manner. The learning process included both face-to-face learning and online learning. It emphasized on activities that encouraged reflections of team members based on their practice. A team leader, who was more experienced, provided support and advice continuously.

Results of the operation We came to a conclusion that the technique of "out-of-thinking" by means of resetting the mind to get back to observe the feeling at a certain part of the body was very helpful in freeing the mind from thinking. The practitioners realized that the more frequent they practiced the freer their mind was from problems. The mind then saw problems as what they really were. Subsequently, a variety of solutions to the problems would be revealed. In conclusion, our team members agreed that trying to get out of thinking and setting the mind to sense the body is an effective approach for making a better life, solving accumulated problems, and improving physical health.

Solutions for applying the research results We would like to expand our technique of 'Resetting to Setting' or Mindfulness to become a learning strategy that can be utilized in all fields of knowledge. The strategy should be integrated into teaching and learning of all subjects. We also plan to operate a new course entitled "Researching oneself for developing one's life". The course will allow learners to have full freedom in their learning. Research methodology will be adopted as a means to help them learn about themselves.

Carlo Fabricatore (University of Worcester), & **Ximena López** (Initium)
The Complex Game of Education
(seminar)

Short description: “The Complex Game of Education” explores the development of a study programme informed by complexity science and game research, and its impacts on student engagement and the broader educational system within which the programme was run. The lens of complexity science provides perspectives important to deal with interwoven challenges and constraints common in formal education systems. The lens of game research allows understanding conditions facilitating motivation and engagement in challenging activities pivoting around meaningful learning.

Abstract: “The Complex Game of Education” is the account of a journey into learning and (higher) education, explored through the lens of complexity and gaming. This journey began in 2010, when the authors engaged in the development of a Baccalaureate in Science (BSc) in Computer Game Design and Development (CGDD) at the University of Worcester (UK). The BSc had to be developed and delivered in a challenging scenario characterized by often conflictive aims. The context of development and delivery of the CGDD BSc was a complex system defined by interwoven challenges originated by non-fully predictable nor controllable factors, and by the need of facilitating learning through engaging experiences regardless of significant contextual constraints.

This motivated the authors to leverage the conceptual frameworks of complexity and gaming to explore, make sense of and cope with such complex scenario. Based on these perspectives, the CGDD BSc was designed to engage students in learning experiences pivoting around team projects set in authentic scenarios. These projects required students to interact with real-world stakeholders, framing and integrating learning activities crafted to offer an appropriate mix of challenges, opportunities for the development of mastery, and related rewards. The learning activities were designed to foster student self-organization, support student heterogeneity, and facilitate the interplay between collective and individual learning. Activities focused students on the importance of learning for their development at an individual and collective level, and to achieve something relevant for their ‘community’.

Data gathered over two years show the positive impacts of the BSc activities in terms of student achievements, motivation, engagement and development. Students demonstrated to be able to learn to cope with uncertainty and changing contextual conditions and constraints, appreciating the value of collaborative activities and working on meaningful issues in meaningful contexts, in terms of both personal development and motivation. The BSc has also demonstrated that study programs can actually be a good opportunity to integrate and benefit both society and academia.

The CGDD BSc has been successfully conceived and developed as a program somewhat atypical if compared to other, more traditional courses delivered within and outside the University of Worcester. And the results have so far been atypical as well. These “atypicalities” made the development and delivery of the program a significant challenge in itself, considering that the program had to fit within a framework of “typical” constraints and requirements (e.g. institutional quality assurance procedures and standards; resource allocation strategies; etc.). Thus, from inception the CGDD BSc was a “game within the game”, requiring the educators involved in the program to be at the same time “game designers”, to architect the framework for the student experience (the “inner game”), and “game players”, to cope with the context conditioning the development of the program (the “outer game”). In turn, the outcomes of the “inner game” generated perturbations eventually driving changes in the “outer game”.

The seminar “The Complex Game of Learning” will highlight salient elements of the educational approaches underlying the CGDD BSc (i.e. the core mechanics of the “inner game”), presenting and discussing some of the most interesting outcomes of the program. Furthermore, the session will discuss the main challenges and approaches to playing the “outer game”, and some key elements of the interplay between the “inner game” and the “outer game”, and its consequences.

A more extended version of this proposal by Carlo Fabricatore and Ximena López is available at <http://www.learndev.org/dl/BtSM2013/FabricatoreLopezExtended.pdf>.

Jan Servaes (City University of Hong Kong, Dept. of Media and Communication):
Homo Academicus, Quo Vadis?
(discussion paper)

Short description: Cultural institutions like universities no longer challenge us or encourage us to question what we know.

Abstract: Universities worldwide have transformed or are about to transform themselves from educational institutions into business-like corporations where quantity rules over quality, form over substance, and management over the homo academicus. Both “internal” conditions (such as social interests, norms, reputation system, social structure, and organization of science) and “external” influences (the relationships between science and other areas of society) affect the development of a scientific community.

In this discussion paper I attempt to highlight some of these internal and external aspects emerging from intellectual, biographical and institutional histories in communication studies to arrive at a rather sobering conclusion regarding the role and place of academics or public intellectuals in today’s society.

See also the book chapter by Jan Servaes on *Homo Academicus: Quo Vadis?* at http://www.learndev.org/dl/BtSM2013/Servaes-Homo_Academicus_2012.pdf.

Paul Heckman (UC Davis), **Richard Roberts** (Coyote Foundation), **Sally Roberts** (Coyote Foundation), & **Viki Montera** (Sonoma State University)
Creating a Counter Narrative about Children's and Middle Adolescence Learning
(Interactive session)

Short description: A prevailing narrative about learning and development influences a Mental Model about schooling, in the U.S., and other nations. This session will examine the narrative and Mental Model. It will also provide a counter narrative, suggesting new guides and practices for learning and development based on the science of learning, cognition, and development. A very different set of learning conditions from those usually used in schooling will be explored in this session.

Abstract: A Mental Model currently dominates in our schools. A prevailing narrative about children's and youth's learning and development influences this Mental Model, which in turn directs individual educators, policy makers, and citizens [all of us] in the everyday conduct of learning in today's typical educational institutions, in the U.S., and other nations. This session will examine the Mental Model and provide a counter narrative to the narrative underlying the model, suggesting new guides and practices for learning and development based on the science of learning, cognition, and development. With these new guides, a very different set of learning conditions, which we will discuss in this session, could then be enacted in formal and informal educational settings.

As the presentation and interactions during the session will demonstrate, the Mental Model crashes and burns against the wall of the research evidence that will be discussed during the session. We have learned an enormous amount about how young people develop intellectually, emotionally, and socially. Yet, despite these powerful insights, firmly grounded in many years of educational and social science research, we have made little progress towards revising our educational practices to take advantage of this new learning. Efforts to introduce new approaches to our educational programs have often been too little, too late.

The consistent findings from the social, cognitive and learning sciences show the importance of learning that is active, meaningful, and socially mediated. These findings also establish a convergent and clear picture of the cognitive, affective, and social processes involved in learning and the conditions that best support it.

The different features of this picture can be expressed in 10 basic principles of effective learning:

1. Good learning provides time and opportunity for in-depth work on specific problems and sets of learning tasks, and gradually deeper immersion in a particular discipline.
2. Good learning is rooted in a community of practice, where less experienced learners can work alongside more experienced peers as well as skilled adult mentors, in real roles recognized by that community.
3. Humans learn best when they feel challenged. Young people need, and over time come to thrive on, working on learning problems that require use of their emergent cognitive and social capacities.
4. Motivation matters in good learning.
5. Good learning recognizes and supports young people's agency.
6. Good learning creates a sense of purposefulness for the learner.
7. Good learning is more than cognitive. It is rooted in, draws on, and engages emotion.
8. Good learning involves work that is assessed in relation to established standards of the discipline at hand.
9. Young people learn best when they have access to a variety of disciplines in order to discover (and develop) interests and strengths.
10. Strong relationships create a pathway along which knowledge travels, and therefore attention to relationships is an important task in creating good learning environments.

See also the paper on *Realizing the Potential on Learning in Middle Adolescence* by Robert Halpern, Paul Heckman and Reed Larson at

http://www.learndev.org/dl/BtSM2013/HalpernHeckmanLarson_MiddleAdolescence.pdf.

BtSM2013 participants are also strongly encouraged to read Paul Heckman's introductory paper on *Setting the Stage for Realizing the Potential of Learning in Middle Adolescence*, available at http://www.learndev.org/dl/BtSM2013/Heckman-Setting_the_Stage.pdf.

Matthew Colless (Research School of Astronomy and Astrophysics, Australian National University)
Beauty and harmony in the service of science and technology
(keynote talk + discussion)

Short description: In reversing the title of BtSM 2013, I am emphasising the role of beauty and harmony in the lived experience of scientific and technological research. Effective scientists develop a clear sense of scientific beauty as a heuristic and emotional response to the fitness problem of selecting amongst competing hypotheses and paradigms. I will discuss my personal experiences and offer an analysis of scientific beauty in terms of 'natural selection' before opening the session to discussion.

Abstract: The experience and activity of scientific research has, for most practitioners, a strong aesthetic component. They find beauty in the field of their research, in the particular problems they choose to address, and – most especially – in effective solutions to those problems.

Many researchers are drawn to science, often to a particular field, by an acute aesthetic response. In my own case, I was drawn to astronomy by two distinct aesthetic pleasures: the sensational beauty of the night sky and the universe beyond, and the logical beauty of the theories that allow us to understand the universe. In the course of my scientific career I have often been guided by my sense of the most beautiful solution to a problem or the most harmonious interpretation of the data. This is a common experience for many if not all scientists, and I will argue that it is a powerful adaptation of the human intellectual apparatus in response to the challenging 'fitness problem' of selecting amongst competing hypotheses and paradigms in the course of scientific research.

In a different context, a clear example of an evolving aesthetic sense in response to a new environment is provided by the adaptation of European artists to the Australian landscape. Initially they attempted to represent this alien environment in terms of familiar European figures and tropes, producing images that were often grotesquely inaccurate and unlovely. However, as their aesthetic sense adapted to the strange and subtle otherness of the Australian bush, the artists (both individually and as a group) evolved new ways of seeing and representing the landscape that were more accurate and more beautiful. Eventually, Australian-born artists with a deep personal experience and love of the country produced work that was both more realistic and more beautiful, and that – significantly – demonstrated real understanding of the landscape.

This evolution in aesthetic understanding provides a close analogy for the gradual adaptation of researchers to the shock of a new discovery or a paradigm shift in their field of research. Initially they view the new facts and ideas through the perspective of their previous experience, old facts and old paradigms. Consequently the new fact or paradigm seems 'ugly' and there is discordance and lack of understanding. Over time, however, researchers (either individually or as a population) adapt their thinking and perspectives in order to accommodate the novelty. The aesthetics of the field changes, and the fresh information is placed in a new ecology of ideas in which it seems natural, right and proper – indeed, beautiful. In this sense, the researchers' aesthetic – their emotional and heuristic sense of fitness – has evolved in order to function effectively in the new order of things.

Viewed in this light, the experience of beauty and harmony in science and technology is a selective adaptation that improves researchers' effectiveness in understanding the world.