



International Council of Associations for Science Education

# WORLD STE2016

5<sup>th</sup> World Conference on Science and Technology Education

**November 1-5, 2016 / ANTALYA / TURKEY**

**Scientific Programme and Abstracts**

**Edited by**

Bulent CAVAS, Ben AKPAN, Gultekin CAKMAKCI



[www.icas2016.org](http://www.icas2016.org)







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Titanic Beach Lara Hotel / ANTALYA / TURKEY

## **SCIENTIFIC PROGRAMME and ABSTRACTS**

ICASE International Council of Associations for Science Education  
<http://www.icaseonline.net>

**5th ICASE World Science and Technology Conference  
Scientific Programme & Abstracts**  
Edited by Bulent CAVAS, Ben AKPAN, Gultekin CAKMAKCI  
November – 2016  
Antalya / Turkey  
<http://www.icase2016.org>

**PAPILLON YAYINLARI**  
İthalat İhracat San. ve Tic. Ltd. Şti.  
Deniz Köşkleri Mah. Dr. Sadık Ahmet Cad.  
Reyhan Sok. No:5/A Avcılar / İstanbul  
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[www.papillonyayinlari.com](http://www.papillonyayinlari.com)  
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ISBN: 978-605-9226-81-3



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**ICASE President's Message**  
**Dr. Teresa Kennedy, ICASE President (2014-2017)**  
**Professor STEM Education, University of Texas at Tyler**

I want to personally welcome you to the 2016 ICASE World Science and Technology Education Conference. The International Council of Associations for Science Education (ICASE) was created in 1972 by the United Nations Educational, Scientific and Cultural Organization (UNESCO) to extend and improve science education throughout the world. I have had the honor to work with the ICASE Executive Committee to accomplish this important goal, and in this spirit, work to serve our partner associations around the world. It has also been a pleasure to work with institutions, foundations and companies whose primary mission is aligned with the vision and mission of ICASE, and to bring this network together, with the goal of facilitating communication and cooperation at international level.

ICASE is a strategic organization. The ICASE Strategic Plan details the Vision of ICASE in 2023, at the point of our 50th Anniversary, and focuses on delivering excellence in Science Education Worldwide. The goal during my presidency has been to continue the path forward, working collaboratively with all members of the Executive Committee toward accomplishing the milestones described in our comprehensive plan. As a result of this work, ICASE has continued on a positive trajectory. For the past three years, we have been working with our member organizations to achieve the goals outlined in the plan and have worked hard to share the milestones achieved by ICASE member organizations in ICASE newsletters and at regional events. The ICASE journal has been restructured with the goal of serving as a truly international venue where member organizations can publish and share successful models for teaching science to children of all ages. In addition, major science organizations have renewed their collaborations with ICASE and many new organizations have joined our network. It is through collaborative networking and the sharing of information that we can extend and improve science education throughout the world.

Some highlights of ICASE accomplishments from 2014-2016 include:

- Strengthened ties with UNESCO. UNESCO continues to acknowledge and support the underlying principles of ICASE.
- Communicated accomplishments and activities of the ICASE member associations through the newsletter. <http://www.icasestonline.net/news.html>
- Presented information about ICASE at science teacher events, serving in an advocacy role for the organization.
- Organized a North America regional meeting for ICASE during the Global Conversations Conference in 2014, 2015 and 2016 in conjunction with the National Science Teachers Association (NSTA) in the United States.
- Established the first ICASE Headquarters Office in Ireland.

I hope you join your ICASE colleagues as we work to fulfill the ICASE mission and vision in a proactive manner by (1) continually reviewing the ICASE strategic plan and goals, (2) striving to maintain and increase collaborations amongst the ICASE member organizations with the aim of disseminating research and sharing innovative educational models, (3) continuing development activities to support the development of projects, services, initiatives and regional professional development events, and (4) continue building our membership bringing the world's STE organizations together.

## **Conference Organizers' Message**

**Ben Akpan, Bulent Cavas, Gultekin Cakmakci**

On behalf of the International Conference Committee we welcome you to the 5th World Conference on Science and Technology, which is organised by ICASE (International Council of Associations for Science Education). It is scheduled for Antalya, Turkey from 1-5 November, 2016. The theme of the conference is Interdisciplinary Practices in Science and Technology Education.

Established in 1973, the objectives of ICASE are to extend and enhance the work of its member organizations; provide and support activities and opportunities to enhance formal and non-formal science and technology education worldwide; establish and maintain an international communication network; and encourage and support the establishment and development of professional science and technology organizations, especially where none currently exists in a country.

In striving towards these objectives, ICASE activities have included the publication and production of teaching resources, organization of conferences, symposia, and workshops as well as the organization of World Conferences on science and technology education.

At its General Assembly in Kuching, Malaysia in 2013, ICASE approved a strategic plan for the future. This includes re-examining the goal of ICASE in order that by its 50th Anniversary in 2023, the vision of the Association to provide the foundation and leadership in Delivering Excellence in Science Education Worldwide could be realized. Thus moving forward, ICASE envisions its role as helping to develop and sustain science teacher associations so that all science teaching is enhanced through collaboration, innovative methodologies and connections throughout the globe. In this direction, ICASE mission is to deliver and coordinate, enact and disseminate research and resources that enhance the impact and growth of science education and science teacher associations throughout every continent.

ICASE World Conferences are, therefore, meant to further the vision and mission of the Association. The first World Conference was held in Penang, Malaysia in 2003. This was followed by other conferences in Perth, Australia (2007); Tartu, Estonia (2010); and Kuching, Malaysia (2013).

On behalf of the International Conference Committee, we would like to thank everyone who has contributed this conference in different capacities and wish all participants a wonderful, rewarding and successful conference.

Thank you.

**Ben Akpan**, *Chair of the International Conference Committee*

**Bulent Cavas**, *Co-chair of the Conference*

**Gultekin Cakmakci**, *Co-chair of the Conference*

## ICASE WorldSTE2016 Conference Committees

### Organizing Committee

Ben Akpan, Nigeria (ICASE WorldSTE Conference International Committees Chair)  
Bulent Cavas, Turkey  
Gultekin Cakmakci, Turkey  
Hamide Ertepinar, Turkey  
Jack Holbrook, Estonia  
Teresa Kennedy, USA  
Sue Dale Tunncliffe, UK  
Lutfullah Turkmen, Turkey  
Sedat Ucar, Turkey

### Scientific Committee

Devrim Akgunduz, Turkey  
Buket Akkoyunlu, Turkey  
Kader Bilican, Turkey  
Yilmaz Cakici, Turkey  
Pinar Cavas, Turkey  
Orhan Curaoglu, Turkey  
Beverley Cooper, New Zealand  
Lindsey Conner, New Zealand  
Asit Kr Das, India  
Kadir Demir, USA  
Hamide Ertepinar, Turkey  
Christiane Gioppo, Brasil  
Elaine Horne, Australia  
Sahin Idin, Turkey  
Elif Ince, Turkey  
James Kaufman, USA  
Gulfem Kaygısız, Turkey  
Declan Kennedy, Ireland  
Tarik Kisla, Turkey  
Piet Kommers, The Netherlands  
Joseph M. Makokha, USA  
Yasemin Ozdem, Turkey  
Ilhan Silay, Turkey  
Steven Sexton, New Zealand  
Manabu Sumida, Japan  
Michael Padilla, USA  
Miia Rannikmae, Estonia  
Sedat Ucar, Turkey  
Bahadir Yildiz, Turkey  
Janchai Yingprayoon, Thailand  
Mamman Wasugu, Nigeria



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SCIENTIFIC PROGRAM

### PROGRAM AT A GLANCE

Time	Tuesday (Nov. 1)	Wednesday (Nov. 2)		
09.00 - 10.00	<b>Registration</b>	Free time	<b>Registration</b>	
10.00 - 10.15		ICASE Executive Committee Meeting-I (Only for Executive Committee Members)	<b>Opening Ceremony</b>	
10.30 - 12.00			<b>Keynote # 1:</b> Dr. Flavia Schlegel, UNESCO Assistant Director-General Natural Sciences Sector Opening Remarks & Dr. Jim McDonald, President, Council of Elementary Science International of the U.S.	
12.00 - 13.30		Free time	Lunch	
13.30 - 14.30			Concurrent session # 1	
14.30 - 14.45			Coffee Break	
14:45 - 15:45	ICASE General Assembly (It will start at 15.30)		Concurrent session # 2	
15:45 - 16:00				
16:00 - 17:00		Workshop session-I		
17:00 - 18:30				
19.00 - 21.00	Dinner	<b>Dennis Chisman` s Oration</b> Jack Holbrook ICASE Projects University of Tartu (17:15-18:30)		

	Thursday (Nov. 3)	Friday (Nov. 4)	Saturday (Nov. 5)
	<p><b>Keynote # 2</b> Prof. Romain Murenzi, UNESCO Division of Science Policy and Capacity Building &amp; Dr. Kadir Demir, Georgia State University</p>	<p><b>Keynote # 3:</b> Ms. Julia Heiss, UNESCO Education Sector &amp; <b>Invited Workshop</b> <b>Janchai Yinprayoon</b> Using Lo-cost Science toys to Teach School Science</p>	Workshop Session-II
	Introduction to Discussion Groups	Coffee Break (10:00-10:15)	Coffee Break (10:30-11:00)
	Discussion Groups	Concurrent session # 3 (10:15-11:15)	Concurrent session # 8 (11:00-12:00)
		Concurrent session # 4 (11:15-12:15)	
	Lunch	Lunch	Lunch
	Excursion * Coffee Break	Concurrent session # 5	Concurrent session # 9
		Coffee Break	Coffee Break
		Concurrent session # 6	Conference Declaration & Closing Ceremony
	Dinner	Departures Concurrent session # 7	
		ICASE Executive Committee Meeting-II (Only for Executive Committee Members)17:00-18:00	

## 1 NOVEMBER 2016

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### **10:00-12:00**

ICASE Executive Committee Meeting (Executive Committee Members Only) – I

**Room: Atlantic 3**

### **15:30-18.30**

ICASE General Assembly

**Room: Atlantic 4**

### **19:00-21:00**

Dinner

## 2 NOVEMBER 2016

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### **09:00-10:00**

Registration

**Room: Atlantic 4**

### **10:00-10:30**

Opening Ceremony

Ben Akpan, ICASE Past President

Bulent Cavas, ICASE President-Elect

### **10:30-12:00**

**Keynote Speaker:**

Dr. Flavia Schlegel

UNESCO, Assistant Director General/Natural Sciences Sector

&

Dr. Jim McDonald, President, Council of Elementary Science International-USA

### **12:00-13:30**

Lunch



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**2 NOVEMBER 2016**

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**13:30-14:30****Concurrent Sessions #1****Room: Atlantic 4****Chair: Ben Akpan**

A framework for Synthetic Biology Education in Ontario, Canada - Designed For Students, by students iGEM Toronto

**Canada**

Predicting Children's Responsible Environmental Behaviors

Fatma Bahar, Elvan Sahin

**Turkey**

Learning Environments of Open Classes: A Content Analysis of An Environmental School Project

Maria Kalathaki

**Greece**

Environmental Sanitation Sustainability Through Adequate Waste Disposal Methods to Eradicate Land Pollution Menace in Uyo Metropolis, Akwa Ibom State, Nigeria.

Aniekan Udongwo, Patrick Uko, Walter Umoh

**Nigeria****Room: Atlantic 2****Chair: Sue Tunnicliffe**

Resource "Science And Picture Book" in Primary Teaching

Bruguiere Catherine, Tunnicliffe Sue

**France, UK**

Promoting Students' Understanding of Chemical Bonding Through an Intervention Based on Constructivist Approach

Sitalakshmi A.Ramamurthi

**India**

Contradiction Results Between Actual Experiments and Science Textbooks in Junior High School

Shuichi Yamashita, Yasuyuki Kashiwaguma

**Japan**

Organization of Contents in Junior Secondary Science Curriculum of Bangladesh

Mohammad Nure Alam Siddique, Kalyani Bain

**Bangladesh**

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**2 NOVEMBER 2016**

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**Room: Atlantic 3****Chair: Jack Holbrook**

Science Education and Students Career Future Success in Employment Environment

Mary Felistas Apio, Frances Atima

**Uganda**

Pros and Cons of the Turkish Education System with the Perspective of Prospective Science Teachers

M. Diyaddin Yasar, Mustafa Sozibilir

**Turkey**

An Explorative Study on Null Secondary Science Curriculum in Bangladesh

Tapashi Binte Mahmud Chowdhury, Mohammad Nure Alam Siddique

**Bangladesh**

Acquisition of Innovative and Entrepreneurial Skills in Basic Science Education for Job Creation in Nigeria.

Maryrose C. Mbanefo, Obiajulu C. Eboka

**Nigeria****14:30-14:45 Coffee & Tea Break****14:45-15:45****Concurrent Sessions #2****Room: Atlantic 4****Chair: Janchai Yingprayoon**

Effective Teaching and Learning in Science Education Through Information and Communication Technology

Francis Donatus Eyenaka, Dr. Patrick J. Uko, Mary Patrick Uko

**Nigeria**

STEM For Life: 21st Century Skills

Buket Akkoyunlu

**Turkey**

Are Digital Technologies Used to Replace Established Teaching Practices and Approaches Or Are They Being Used to Innovate?

Jude Sanders, John Oversby

**Ireland, UK**

Using Cutting Edge Anatomage Technology in the Study of Human Anatomy

Stephanie Hutchins

**USA**

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**2 NOVEMBER 2016**

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**Room: Atlantic 2****Chair: Miia Rannikmaa**

Assessment of the Professional Development of Science Teachers : Implications For Quality Assurance in Secondary Science Education

Obiajulu C. Eboka, Maryrose C. Mbanefo

**Nigeria**

The Effectiveness of Problem-Based Learning on Qatari Students' Academic Achievement And Problem-Solving Skills In Biology

Ashraf Kan'an, Kamisah Osman

**Jordan**

Assessing Teacher Candidates' Opinions on Sustainable Food Consumption in the context of Education for Sustainable Development

Ayse Dogrubak, Elvan Sahin

**Turkey**

Turkey's Ambition on Science Centres: Explainers' and Teachers' Views on Their own Professional Development

Eray Şentürk, Fitnat Koseoglu, Uygur Kanlı, Semra Tahancalıo, Gültekin Çakmakçı

**Turkey**

**Room: Atlantic 3****Chair: Manabu Sumida**

Psychological Factors and Secondary School Students' Academic Performance in Mathematics

Eduwem, Joy Dianabasi, Umoinyang, Imo Edet Otu, Bernard Diwa

**Nigeria**

The Views of Students and Team Coaches About Robotic Competitions (The Case of First Lego League)

İsmail DÖNMEZ, Seraceddin Gürbüz

**Turkey**

Assessment of the Challenges Limiting the Use of Information and Communications Technology Tools in Teaching and Learning in Tertiary Institutions in South-South Nigeria

Lawrence Aguele

**Nigeria**

Collaborative Web-based Learning through Lesson Study: Professional Development of Science Educators

Manabu Sumida, Heiwa Muko, Atsushi Ohashi

**Japan**

**15:45-16:00 Coffee & Tea Break**

## 2 NOVEMBER 2016

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**16:00-17:00**

### WORKSHOP SESSIONS

**Room: Atlantic 4**

Creative Science Workshop for Early Childhood Learning

Janchai Yingprayoon

*Thailand*

**Room: Atlantic 3**

Science Teacher Associations - University Partnership: What Can Be Done To Promote Science Related Career Awareness Among Students?

Miia Rannikmae

*Estonia*

**Room: Atlantic 2**

A Review of the Laboratory Safety Guidelines Project: A Session Workshop Exercise

Robert Worley

*UK*

**17:15-18:30**

**Room: Atlantic 4**

Special ICASE SESSION

Dennis Chisman`s Oration

Jack Holbrook

Professor of Science Education and ex - ICASE President and current International Projects

**19:00-21:00 Dinner**

## **3 NOVEMBER 2016**

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***Room: Atlantic 4***

***09:00-09:30***

**Keynote Speaker**

Prof. Romain Murenzi – UNESCO

***09:30-10:00***

**Keynote Speaker**

Kadir Demir, Georgia State University, USA

***10:00-10:15***

**Introduction to Discussion Group**

Room: Atlantic 4

***10:15-10:30***

**Coffee Break**

***10:30-12:00***

**Discussion Groups**

***Room: Atlantic 4***

***12:00-13:30***

**Lunch**

***13:30-18:00***

**Excursion**

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## 4 NOVEMBER 2016

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**09:00-09:30**

**Keynote Speaker**

*Ms. Julia Heiss*

UNESCO Education Sector

*Room: Atlantic 4*

**09:30-10:15**

**Invited Workshop**

*Janchai Yinprayoon*

Using Lo-cost Science toys to Teach School Science

*Room: Atlantic 4*

**10:15-11:15**

**Concurrent Sessions #3**

***Room: Atlantic 4***

***Chair: Steven Sexton***

The Effect of Inquiry Based Science Education on the Students' Science Process Skills

İlhan Silay, Fatih Önder

*Turkey*

Attitude of Undergraduate Students Towards Entrepreneurial Studies in University of Calabar

Otu, Bernard Diwa Eduwem, Joy Dianabasi Umoinyang, Imo Edet

*Nigeria*

Evaluation of Preservice Science Teachers' Views Towards Responsible Research and Innovation (RRI)

Bulent Cavas, Cagla Bulut

*Turkey*

Scaling up an iMVT Science Learning Model as An Effort of Globalization in China

Baohui Zhang, Ruimeng Cheng, Yanjuan Han

*China*

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## 4 NOVEMBER 2016

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### ***Room: Atlantic 2***

***Chair: Bulent Cavas***

Drama for Inclusion in Science

John Oversby, Jane Fieldsend, Jude Sanders

***UK***

Assessment of Learning Activities for Fostering Creativity in Senior Secondary School Physics Students

Agommuoh P. C., Nzewi U. M.

***Nigeria***

Design-based science learning approach: Exploring students' collaborative problem-solving

Katrin Vaino, Toomas Vaino

***Sweden, Estonia***

A New Approach to Teach Earthquake Concept Using SSE Project

Bulent Cavas

***Turkey***

### ***11:15-12:15***

### **Concurrent Sessions #4**

### ***Room: Atlantic 4***

***Chair: John Oversby***

An Assessment of New Science Curriculum in Terms of Laboratory Usage

Bulent Cavas, Simge Akpullukçu Koç

***Turkey***

Effective Application of Facilitation Techniques Approach for Promoting Creativity in Basic Science Students

Maryrose C. Mbanefo

***Nigeria***

Grade Nine Students' Interest towards Science Topics Presented in Different Contexts Moonika

Teppo, Miia Rannikmae

***Estonia***

The Maker Movement in Pre-school Education: A Case Study Using MaKey MaKey

Gökben Yılmaz Turgut, Tarık Kışla

***Turkey***

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## 4 NOVEMBER 2016

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**Room: Atlantic 2****Chair: Sedat Ucar**

Assessment of Emotional Intelligence, Perceived Self-Efficacy and Academic Achievement of Science, Technology And Mathematics Education Students In Jos,

Bernadette Ebele Ozoji, Christiana Amaechi, Ugodulunwa Beatrice Ahmadu Bahago

**Nigeria**

Views of Teachers Participated in Pilot Workshop on Teacher Professional Development towards Science Centres

Eray Şentürk, Fitnat Köseoğlu, Hilal Yanış, İpek Pirpiroğlu, Semra Tahancalıo, Uygur Kanlı

**Turkey**

Bayer Kimlu Science Camp: A Place For Inspiring the Next Generation of Science Leaders

Contreras-Villarroel, Oscar Maturana, Joyce Parra, Marjorie Guzmán, Eduardo

**Chile**

Change of Preservice Teachers' Entrepreneurial Tendency throughout the Teacher Training Program

Sedat Ucar

**Turkey**

### **12:30-13:30 Lunch**

### **13:30-14:30**

### **Concurrent Sessions #5**

**Room: Atlantic 4****Chair: Katrin Vaino**

Assessment of College Students' Attitudes and Motivation Towards Solid Waste Management In Pankshin, Nigeria.

Mohammed Dauda Dung, Mangut Mankilik, Bernadette Ebele Ozoji

**Nigeria**

Designing An Ice-Cream Machine: An Attempt to Combine Engineering with Science Learning

Anneli Vahealu, Katrin Vaino

**Estonia, Sweden**

Evaluation of The Usability And Challenges Facing The Adoption of Online Based Cloud Services In National Open University of Nigeria, North Central Zone.

Dorcas Tabitha, Wusa Ajayi, Bernadette Ebele Ozoji

**Nigeria**

Natural History Diorama: An opportunity of historical and experimental science with children

Eirini Gkouskou, Sue Dale Tunnicliffe

**UK**



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**4 NOVEMBER 2016**

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**Room: Atlantic 2****Chair: Baohui Zhang**

Profile of The Pedagogical Heads of School Environmental Projects

Maria Kalathaki

**Greece**

Creative Problem Solving Process as a Tool for Developing Biology Teaching Skills

Merike Kesler

**Finland**

Mapping of Environmental Education in Jambi Province

Robert Steele, Ely Djulia, Ida Darmapatni, Stien Matakupan, David Zandvliet, Hari Wijayanto, Rayandra Asyar, Sufri, Muhammad Yusuf, Dairabi Kamil

**Indonesia**

The View of Science Teachers Relation to Social Justice and Equity Concepts

Şahin İdin, Cemil Aydoğdu

**Turkey****14:30-14:45 Coffee & Tea Break****14:45-15:45****Concurrent Sessions #6****Room: Atlantic 4****Chair: Sue Dale Tunnicliffe**

What's Inside? The Development of Childrens' Understanding of Organisms

Sue Dale Tunnicliffe

**UK**

A Micro-Analytic Investigation of Inquiry Process in Science Classroom

Metin Sardag, Gokhan Kaya, Gultekin Cakmakci

**Turkey**

Improving Scientific Literacy Through Science Teaching

Joseph, Endurance Ayibatonye Glory Godpower-Echie, Sopuruchi Ihenko

**Nigeria**

Experimental Skills in High School Chemistry Class in Turkey and France

Zeki Bayram

**Turkey**

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## 4 NOVEMBER 2016

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### **Room: Atlantic 2**

### **Chair: Yılmaz Çakıcı**

The Assessment of Preservice Science Teachers' Understanding of the Concept of Atmospheric Pressure

Aybuke Pabuccu

*Turkey*

Does Developed Mean More Advanced: STEM Teacher Training in Uruguay, A Case Study.

Jude Sanders, John Oversby

*Ireland, UK*

The Views of Science Teachers About Gender Equity in Science Education

Şahin İdin, İsmail Dönmez

*Turkey*

Exploring Pre-service Primary Teachers' Drawing of the Digestive System

Yılmaz Çakıcı

*Turkey*

### **15:45-16:00 Coffee&Tea Break**

### **16:00-17:00**

### **Concurrent Sessions #7**

### **Room: Atlantic 4**

### **Chair: Ben Akpan**

Practical Chemistry in Rooms?

Robert Worley

*UK*

Educational Options for Oil Pollution Reduction in The Niger Delta Region of Nigeria

Oluseun Modupe Bolorunduro, Felicia Imeh Umanah

*Nigeria*

Practical Work Provoked and Promoted by the History of Science: A Way into the Nature of Chemistry

John Oversby

*UK*

Scientific Skills And Concept Learning By Rural Women For Personal and National Development

Felicia Onyemowo Agbo (FSTAN)

*Nigeria*

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## 4 NOVEMBER 2016

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### ***Room: Atlantic 2***

***Chair: Kadir Demir***

A PROFILES Based Teaching and Learning Module: How can we create an ice-cream car which goes on the beach using wind?

Bulent Cavas, Selin Nur Sayar, Sercan Senel

***Turkey***

Information and Communications Technologies in Science Education Teaching: Relevance And Applications

Joseph, Endurance Ayibatonye, Enwere, Kathryn Ify

***Nigeria***

Gymnasium students' conceptions of technology and orientations towards technology related careers

Toomas Vaino, Katrin Vaino, Miia Rannikmäe

***Estonia, Sweden***

### ***17:00-18:00***

ICASE Executive Committee Meeting (Exec. Committee Members Only) – II (Room: Atlantic 3)

### ***19:00-21:00 Dinner***

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## 5 NOVEMBER 2016

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**09:00-10:30**

### Workshop Sessions

**Room: Atlantic 4**

**Chair: Janchai Yingprayoon**

The Maker Movement in Pre-school Education: A Case Study Using MaKey MaKey

Gökben Yılmaz Turgut, Tarık Kışla

*Turkey*

**Room: Atlantic 2**

**Chair: Orhan Curaoğlu**

Enriching Science and Technology Courses with Arduino

Bahadır Yıldız, Orhan Curaoğlu

*Turkey*

**10:30-11:00 Coffee & Tea Break**

**11:00-12:00**

### Concurrent Sessions #8

**Room: Atlantic 4**

**Chair: Miia Rannikmaa**

Action Research: Organising A Virtual Conference on Science Education Justice and Inclusion

John Oversby

*UK*

Informal Contexts to Improve Nature of Science Views

Bahadır Han, Kader Bilican, Yasemin Ozdem Yilmaz

*Turkey*

Effect of Teaching Biological Gardening on Science Students' Attitudes Towards Entrepreneurial Skills Acquisition For Job Competency

Charity Dimlong, Bernadette Ozoji, Florence Osasebor, Yohanna Tagans

*Nigeria*

Vocational Acquisition of STEM Teachers in CERN Workshops

Mustafa Hilmi Çolakoğlu

*Turkey*

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**5 NOVEMBER 2016**

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**Room 2: Atlantic 2****Chair: Buket Akkoyunlu**

Classroom Interaction Practices and Students' Learning Outcomes in Physics: Implication for Teaching -Skill Development for Physics Teachers

Emmanuel E. Achor, Danjuma Ibrahim, Agaptus B. C. Orji

**Nigeria**

Linking Science and Technology Education Communities in China

Baohui Zhang

**China**

A New Look at Science Education in Early Childhood? Teachers' Perceptions of Scientific Curiosity And Best Practice Examples

Ornit Spektor-Levy, Sue Dale Tunnicliffe

**Israel; UK**

An Analysis of Primary Teacher Candidates' Ideas about the Human Body

Yılmaz Çakıcı

**Turkey**

**12:00-13:30 Lunch****13:30-14:30****Concurrent Sessions #9****Room: Atlantic 4****Chair: Gultekin Cakmakci**

Cracken Reflexive Thought through Bracken

Steven S Sexton

**New Zealand**

The Views of Science and Social Sciences Teachers on Their Professional Development Within The Student Achievement

Mustafa Hilmi Çolakoğlu, Şahin İdin

**Turkey**

Mathematics and Science For Life (Mascil): The Nature of Professional Development

Gultekin Cakmakci, Buket Akkoyunlu

**Turkey**

The Challenges of Teachers on the Use of Digital Textbooks in the Classroom in Elementary Schools

Fattum Amtiaz, Salman Esmael, Najami Nami

**Israel**

## 5 NOVEMBER 2016

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***Room: Atlantic 2***

***Chair: Baohui Zhang***

ICASE Journal: Science Education International  
Baohui Zhang, Jack Holbrook, Bulent Cavas  
*China, Estonia, Turkey*

***14:30-14:45 Coffee & Tea Break***

***15:00-16:00***

***Room: Atlantic 4***

**Conference Declaration & Closing ICASE 2016**



International Council of Associations for Science Education

# WORLD STE2016

5<sup>th</sup> World Conference on Science and Technology Education

**November 1-5, 2016**

Titanic Beach Lara Hotel / ANTALYA / TURKEY

ABSTRACTS

## **A FRAMEWORK FOR SYNTHETIC BIOLOGY EDUCATION IN ONTARIO, CANADA - DESIGNED FOR STUDENTS, BY STUDENTS**

*iGEM Toronto*

*University of Toronto, Canada*

Synthetic biology is the deliberate design and construction of a biological system to produce effects that would not ordinarily occur in nature. It is a key enabling technology which can potentially transform the field of modern biological research, to the benefit of the bioeconomy and society. Synthetic biology also holds tremendous promise for future economic growth and job creation, with a predicted total impact reaching at least 100 billion USD by 2025. The future expansion of this sector hinges on the ample supply of skilled laborers as well as increased awareness of its potential contribution to societal benefit. In collaboration with the Ontario Genomics Institute and the University of Toronto, we have developed a module to be incorporated into the grade 12 biology curriculum in Ontario, and have designed a university course to serve as a basis for a proposed program in synthetic biology.

NOTE: we are a student group at the University of Toronto called iGEM Toronto <http://igem.skule.ca/>. We will be finalizing and piloting this project over the upcoming summer and fall.



## PREDICTING CHILDREN'S RESPONSIBLE ENVIRONMENTAL BEHAVIORS

*Fatma Bahar, Elvan Sahin*

*Middle East Technical University, Turkey*

Environmental deterioration has reached a critical point in recent years all over the world. Children with their potential in resolution of environmental issues in future are required to be well equipped with the necessary skills, knowledge, values and attitudes toward the environment and sustainability. Thus, the present study aimed to assess (1) Turkish middle school students' environmentally responsible behaviors, connections with nature (nature relatedness), and motive concerns and (2) the power of the constructs namely environmental motive concerns and nature relatedness in predicting middle school students' environmentally responsible behaviors. For this specified purpose, a survey covering Nature Relatedness Scale (Nisbet, Zelenski & Murphy, 2009), Environmental Motive Concerns Scale (Schultz, 2001), and Children's Responsible Environmental Behavior Scale (Erdogan et al. 2012) was administered to 1774 seventh and eighth grade public school students in north part of Turkey. Regarding the gender distribution, 820 students (46.2%) were female while 824 students (46.4%) were male and 130 students (7.4%) did not label their gender. The results of descriptive statistics indicated that these students reflected an external, nature-related worldview. Regarding their behaviors, it was revealed that the middle school students frequently engaged in some actions linked to physical and economic contribution to the environmental quality. However, these students did not demonstrate some actions on political commitment although they were very concerned about the environmental issues. Examining the predictors of children's responsible environmental behaviors, the linear combination of the attributes reflecting nature relatedness, and biospheric and altruistic motive concerns was significantly contributed to explain such kind of behaviors. The findings of the present study provided practical tips for environmental and sustainability educators in that children could get in touch with nature and have some opportunities to appreciate value of being in nature.

## LEARNING ENVIRONMENTS OF OPEN CLASSES: A CONTENT ANALYSIS OF AN ENVIRONMENTAL SCHOOL PROJECT

*Maria Kalathaki*

*Regional Educational Directorates of Crete, Greece*

The educational activities sustain the process of learning if they are well designed and fitted to the group that they addressed. According to Bruner, everything can be taught if it can be offered in an appropriate way, suitable to be realized and absorbed by each learner and group, in individual and team learning procedure. The team cooperation learning can be achieved, even in heterogeneous groups, if they treat with a specific topic in order to discover a subject, to produce a result, present, and evaluate it. Modern learning environments must be designed to facilitate active and collaborative learning processes, to help students understand and not to memorize, to promote change of their ideas and to bridge the gap between the activities that take place in the school and those that are authentic cultural actions. Environmental Education (EE), in the transformation to the Education for the Sustainable Development (ESD) opens the schools in society with expanding communication, developing partnerships with local authorities and institutions, involving parents and specialists, by ICTs use. The Greek School Environmental Education Projects promote discovery learning, mainly with team work, by involving local communities, scientists, organizations, authorities and bodies, carrying largely in computing and natural environments.

The research aimed to bring out and clarify those characteristics of the learning environments which make them effective and sufficient to classrooms that open to the society, to the local communities. The implemented school environmental project had designed to meet the principles of Environmental Education and Education for the Sustainable Development with many and varied activities inside and outside the school, exploiting local communities, targeting to the protection and sustainable management of natural and artificial ecosystems for a better quality of life. The studied project implemented by a Greek Lyceum with many and varied activities, inside and outside the classrooms, with local communities of two different and distant environments of south and north Greece, at Crete and Macedonia.

Teachers implemented the project in these learning environments in order to encourage students in active experiential learning and collaborations with local authorities and experts, enabling students to learn deeply the need of environmental care and ecological sustainability.

The research on the characteristics of indoor and outdoor learning environments (Cyber-space, Classrooms, Laboratory of Natural Sciences, School Library, the Field and Local Communities) carried out with the aim to clarify those characteristics of the learning environments that support efficiently the experiential and inquiry learning outside the classrooms. The archival printed and digital material examined in a structured manner, making discourse analysis looking for the components and characteristics of the Learning Environments for open classes, grouped into areas.

## **ENVIRONMENTAL SANITATION SUSTAINABILITY THROUGH ADEQUATE WASTE DISPOSAL METHODS TO ERADICATE LAND POLLUTION MENACE IN UYO METROPOLIS, AKWA IBOM STATE. NIGERIA.**

*Aniekan Udongwo, Patrick Uko, Walter Umoh*

*Akwa Ibom State College of Education, Afaha Nsit., Nigeria*

This research work was carried out to investigate the nature of land pollution and waste disposal methods in Uyo metropolis in a bid to work out strategies that will sustain recommended and acceptable environmental sanitation for the city. Structured interview and on the spot-observation were the major techniques employed to elicit information from the residents and industrial plant operators in the area. The sample audience consisted of 200 respondents (100 environmentally educated people and 100 environmentally uneducated people). The study revealed that sources of land pollution in the city include indiscriminate dumping of waste by local residents, commercial and industrial wastes, agricultural wastes, poor management of municipal sewage and garbage disposal systems, poor drainage for new roads and houses constructed. Though garbage bins are provided along the streets, in markets, schools, hospitals and in residential houses, refuse were still being disposed of indiscriminately. Findings revealed that people with basic environmental education adopted more appropriate methods of waste disposal as recommended than those without basic environmental education. It was also found out that there was no strict compliance with the waste disposal policy of the Environmental Department by the industrial and farm operators. Recommendations were therefore put forward for the generality of the population to be exposed to basic environmental education for a healthy environment.

## RESOURCE “SCIENCE AND PICTURE BOOK” IN PRIMARY TEACHING

*Catherine Bruguiere, Sue Tunnicliffe*

*University of Lyon, France*

Within the framework of collaborative research involving French primary teachers and research on the function of narrative in scientific learning, we have developed teaching resources called “Sciences and picture book”. Each resource is designed on one realistic fiction picture book, which is associated with didactic and pedagogical components. We have conducted a study about how the primary teachers use these resources by observing the teachers in class and by collecting questionnaire filled by the teachers. In this communication we propose to describe the design process of the resource “Science and picture book” and to present under which conditions the primary teachers appropriate these resource. This work would be continuing in England.

## PROMOTING STUDENTS' UNDERSTANDING OF CHEMICAL BONDING THROUGH AN INTERVENTION BASED ON CONSTRUCTIVIST APPROACH

*Sitalakshmi A. Ramamurthi*

*Miranda House, University of Delhi, India*

This paper presents a study conducted by the author in a school in Delhi, India, in which an attempt was made to facilitate senior secondary school students' conceptual understanding of chemical bonding through intervention sessions based on constructivist principles. Researches in the learning and teaching of chemical bonding (Coll and Treagust (2003) , Nicoll (2001) and Taber (1997, 1998) ) have brought out students alternative conceptions in bonding after formal instruction in the concepts. Researchers have suggested a change in the pedagogical approach to teach bonding (Levy Nuham et al. (2010)). Studies have also brought out the need for research on teaching strategies to address students' alternative conceptions about bonding (Unal et al (2006)).

In the Indian context, while there has been an increasing use of technology enabled learning resources in the classroom in the past decade, there is need for research on use of teaching-learning strategies which promote active participation and greater engagement of students in the process of learning. Recognising this need, an interventional study designed on constructivist principles was conducted by the author in a regular classroom of Class XI with 35 students in a school in Delhi. Students' pre conceptions of bonding were determined through open ended questions, student generated atomic level diagrams followed by in depth conceptual interviews of students who agreed to be questioned further. Analysis of students' preconceptions revealed alternative conceptions as well as partial understanding of the scientific constructs. Intervention sessions were then designed with the purpose of facilitating students understanding of bond as a force of attraction, as emphasised in recent literature (Levy nuham et al, 2010 ) and energy minimization associated with bond formation. External representations (like static atomic level pictures, dynamic visualisations, graphs, tables, text, as well as student's self generated diagrams) along with peer interaction and students' reflections on their new learning, were incorporated into the intervention for facilitation of restructuring of ideas.

Change in conceptions of individual learners was studied using a pre test, post test, delayed post test design. Data included student generated diagrams, written explanations, responses to in-depth conceptual interviews, students' jottings in their reflective journals and researcher's field notes. This paper presents a qualitative analysis of change in individual students' conceptions as a result of the intervention. It was found that the intervention sessions facilitated students' understanding of 'chemical bond' beyond the 'completion of octet' to bond in terms of 'forces' and energy minimization. For the ionic bond, all students progressed to the idea of the 'ionic lattice' at the end of the intervention. However, not all students retained this understanding till the delayed post test and alternative conceptions related to 'molecules in the ionic compound', resurfaced. Implications for pedagogy are discussed.

This paper also presents students' perceptions on how the teaching learning strategies in the intervention impacted their learning. The paper further discusses some points of concern related to use of the strategies in the prevailing situation in the Indian science classes at the senior secondary level.

## **CONTRADICTION RESULTS BETWEEN ACTUAL EXPERIMENTS AND SCIENCE TEXTBOOKS IN JUNIOR HIGH SCHOOL**

*Shuichi Yamashita, Yasuyuki Kashiwaguma*

*Chiba University, Japan*

The TIMSS 1999 video study clarified the characteristics of the Japanese grade 8 science lessons and teachings in Japan. The study concluded that independent practical work played a crucial role in the development of main ideas. The Japanese course of study was revised dramatically in 2008, and emphasized students' first-hand involvement with practical science activities.

Therefore, students obtain their ideas from the result of experiments than before.

If the result contradicts their textbook, it will be an obstacle in proceeding to their science lesson.

The purpose of this research was to determine the experiments which textbook's results are difficult to understand and produce the outcomes.

There are forty-five junior high school science teachers were asked to answer 88-item questionnaires about laboratory experiments which outcomes were deemed difficult to come up with.

As a result of the questionnaire, biology and chemistry fields are difficult to lead the textbook result, especially 81% of the teachers answered the law of multiple proportions based on oxidizing copper.

With these results, we already developed and still developing the new way to oxidize copper, in which we could improve the experiment and come up with a new outcome.

## ORGANIZATION OF CONTENTS IN JUNIOR SECONDARY SCIENCE CURRICULUM OF BANGLADESH

*Mohammad Nure Alam Siddique, Kalyani Bain*

*University of Dhaka, Bangladesh*

This paper presents the organization of contents in junior secondary science curriculum of Bangladesh. The research questions of this study focus on how science contents are sequenced and integrated in junior secondary science curriculum; they are also focused on the views and understanding of science teachers on different aspects of organization of contents and how their classroom practice is being influenced by their views and understanding on it. A new curriculum has been developed in 2012 by National Curriculum and Textbook Board (NCTB) and implemented throughout Bangladesh in 2013 where all the students study 'Science' as a unified subject at junior secondary level which consists of grades VI-VIII. The subject 'Science' at junior secondary level includes contents from different sub-discipline of science i.e. Physical Science, Biological Science, Earth and Space Science, and Environmental Science. Junior Secondary Science aims at developing scientific attitudes of students as well as providing foundation for pursuing science education at higher level. A qualitative research approach has been followed to conduct this study. Document analysis of junior secondary science curriculum and textbooks has been carried out to answer two of the research questions. Selected parts of the curriculum and textbooks have been analyzed for this purpose. A multiple case study approach has been followed to obtain answers of the other two research questions. Four science teachers and their classroom were selected conveniently as four cases. Classroom observation and interview of the teachers were used for collecting data. For each of the cases, open observation of his/her classroom session was done at first and then a follow up interview with the teacher was conducted by using interview schedule. Four single cases were built by using the data obtained from the interviews of each of the individual teachers and observation of respective teacher's class. Then a cross case analysis was done from which major themes emerged. This study finds that current intended science curriculum at junior secondary level is not well-organized in terms of sequencing and integration. No principle of sequencing contents is followed for sequencing contents within a chapter in most of the cases. Some principles are followed discretely for sequencing contents vertically from one grade to another but it can be said that 'spiral sequencing' is also not followed in most cases. Current curriculum also does not integrate the contents adequately; linking among different sub-disciplines of science has been tried to establish but the level of integration is very low in most cases. Integrating Science with other disciplines has not been found. This study also finds that teachers does not have adequate and clear ideas on organization of contents; in practice, they mainly follow the single textbook published by NCTB in making decision about sequence and integration of contents. Thus, their teaching presents Science as a discrete body of knowledge rather than as an integrated and well sequenced subject. These findings have implications for curriculum developers, textbook writers and for the field of teacher education and training. This study recommends that curriculum developers may make efforts to make the contents well-organized in curriculum by following principles of sequencing and integration and then textbook is written accordingly by textbook authors. Bachelor of Education (B. Ed.) and other teacher training programs may emphasize on organization of content so that future and current teachers have a better understanding of importance and ways of organizing science content in their teaching.

## SCIENCE EDUCATION AND STUDENTS CAREER FUTURE SUCCESS IN EMPLOYMENT ENVIROMENT

*Mary Felistas Apio, Frances Atima*

*Ministry of Education and Sports, Uganda, Uganda*

Uganda is one of the countries in sub Saharan Africa experiencing youth Unemployment with about 64% of the youth living without employment and this is as a result of lack of relevant skills in the science oriented careers where more employment opportunities still exist and the job market is “Flooded” with pure Arts Graduate with limited opportunities. During the last centuries, science education was not emphasised and a majority of students looked at it as so difficult and was meant for certain type of people the “intelligent students”. Promoting science Education and skill development at all levels is government priority through Ministry of Education and Sports. The young people who excel in science, technology, engineering and mathematics related career fields may be able to successfully face the changing business environment of today and tomorrow.

Given the rapid population growth, three quarters of the population are below the age of 15-30 years couple with the fact that youth are getting better education through the government policies; Universal Primary Education (UPE), Universal Secondary Education (USE), Universal Post ‘O’ Level Secondary Education and Training (UPOLET) that has enable many to access primary and secondary education, and consequently high enrolment at tertiary and university, a strong focus on job creation for this cohort transiting from one level of education to another cannot be over emphasised. Assessing the various government interventions in education is imperative in developing and implementing science education.

Although science education in Uganda like in other developing countries is encouraged as a way of minimising unemployment challenges, many challenges continue to underpin the efforts. it has been noted that youth unemployment is as a result of inadequate investment /supply side of jobs, insufficient employable skills is one of the major challenge (i.e. youth posses skills that are not relevant with the available jobs in the industrial sector and science based employment and high rate of labour force growth at 4.7 percent per annum. The education system should be toiled towards addressing the skill gaps as well as investment industrial development.

Inadequate career guidance services in educational institutions posses a great challenge as far making appropriate choices of the subjects that would enable the youth to enter into science based careers where opportunities are available. Gap in the curriculum were some of the causes of inadequate skills and the curriculum has been so theoretical at all levels. The increasing importance of work life flexibility and life career engagement plus gaining employment requires flexible approaches to career and education choices, starting at school level age. Little is known about the ways in which labour market changes affects student’s choice of subjects and education related expectations and aspirations of the young people

Negative attitudes on science based subjects and vocational skills are great challenges leading to low enrolment. In addition, the BTVET programs continued to face the problem of lack of infrastructure for undertaking practical lessons and thus has resulted into low cost



skills training that are not matching with the labour market demands and a majority are privately owned with no or insufficient funding by the government. It is true that many BTVET institutions manage the institution under capacity and those government institutions who have the facilities have no students to use the facilities caused by negative attitudes and stereotyping

There is low staff establishment at all education levels, especially for science, mathematics, English language, and computer science and laboratory technicians in rural schools (MOES)

A number of reforms have been made in the area of education to promote science education and skill based learning and career engagement and it is hope that most youth will enter into the job markets and may be able to create self employment. Government is working hard to promote science-based subjects as a way of promoting science and technology for national development through secondary curriculum review and the policy of compulsory science education at lower secondary was put in place. This is meant to increase the number of students who can join vocational and technical institutions and increased number of those who are taking science subject combinations at Advanced level of secondary education and consequently to the tertiary and university science based courses.

Government is investing in the construction of the science labs and affirmative action on the recruitment of teachers and teacher's science allowance has been enhanced and all this is geared to improve science education which has been lagging behind. And government scholarship opportunities and loan scheme emphasis science based courses.

## PROS AND CONS OF THE TURKISH EDUCATION SYSTEM WITH THE PERSPECTIVE OF PROSPECTIVE SCIENCE TEACHERS

*M. Diyaddin Yasar, Mustafa Sozbilir*

*Atatürk University, Turkey*

Education in general and science education in particular covers a long period of time in Turkey. However, as Keser (2005) pointed out, though education systems, science teaching and science curricula are designed in consideration of the concept of the modern era, they prove ineffective in practice due to various reasons. These include inadequate preparation by teachers or incapacity of teachers, the use of ineffective learning-teaching techniques/methods and assessment methods, overcrowded classrooms and lack of teaching materials and so on. It is seen in both national and international studies that science teaching suffers from serious shortcomings in Turkey compared with other countries (Özden, 2007). It is also seen that studies which aim at identifying problems in the Turkish education system and science education and proposing solutions are not widespread. In our country, an individual needs to exert efforts for a long time in order to acquire a profession in science field and to be a teacher of science until the end of the tertiary education. Bearing this in mind, we would like to know what prospective science teachers think about the education system in Turkey throughout this time. What kind of problems do they face? What needs to be done for better science education and implementation of the education system? This study is expected to bring considerable contribution to the literature as an attempt to answer these questions. This study is carried out with the intention of identifying the current problems of the Turkish educational system and offering solutions in the light of the prospective science teachers' views. It is aimed at shedding light onto the shortcomings of the education system as well as its consequences for science education, and developing solutions to overcome the current shortcomings.

The participations consists of 518 (336 female and 182 male) prospective science teachers at their final year (senior) in nine different universities during the 2013-2014 academic year. An opinion determination form comprised of open-ended questions is used as a data collection instrument. Study data are subjected to content analysis.

The findings of the study showed that the problems and proposed solutions found from the study are grouped under four main headings: structural-administrative problems (32.18%) and solutions (32.54%); teaching-learning problems (35.18%) and solutions (34.35%); problems related to teacher training (23.84%) and solutions (26.94%) and problems related to assessment (8.8%) and solutions (6.17%). As a conclusion, various proposals are made based on the research findings.

### References

- Keser, Ö. F. (2005). Recommendations towards developing educational standards to improve science education in Turkey. *The Turkish Online Journal of Educational Technology*, 4(1), 46-53.
- Özden, M. (2007). Problems with science and technology education in Turkey. *Eurasia Journal of Mathematics, Science & Technology Education*, 3(2), 157-161.

## **AN EXPLORATIVE STUDY ON NULL SECONDARY SCIENCE CURRICULUM IN BANGLADESH**

*Tapashi Binte Mahmud Chowdhury, Mohammad Nure Alam Siddique*

*Institute of Education and Research, Bangladesh*

This study aimed to figure out the topics of secondary science curriculum that are intentionally not covered while teaching learning activities take place, the reasons behind the omission and its impact on students learning in the context of Bangladesh. A qualitative approach has been taken to find out the answers of the research questions of this study. Data were collected from students using focus group discussion to know what topics are left behind in classroom. Teachers were selected conveniently and interviewed to know what they exclude from their teaching and what the reasons behind the exclusion are. Data collected from students and teachers have been analyzed thematically. Then purposefully selected curriculum developers, textbook authors and teacher educators were interviewed to understand the impact of the null curriculum on students learning.

Analysis of data revealed that all the participant teachers exclude a chapter on adolescence, sexual and reproductive health and evolution in grade IX-X general science textbook. This chapter includes information about reproductive organs, physical and psychological changes during puberty, pregnancy, test-tube babies, evolution and related topics, the curriculum developers included a chapter addressing these topics. In the cultural context of Bangladesh, such topics are never openly discussed, rather considered as a taboo to be kept hidden. The curriculum developers and the textbook authors had a mind-set that including these topics will solve a few problems, like adolescent mistakes, child rape, child pregnancy, distorted fantasies or misconception about intercourses. Teachers revealed that the topics are uncomfortable for them to teach, contradicts with religion, students are not proper aged to know the topics, students might misinterpret and practice unethical relationships if these topics are formally open to discuss. This study concluded that excluding the chapter on adolescence, sexual and reproductive health and evolution obstructs achievement of students' scientific literacy.

## **ACQUISITION OF INNOVATIVE AND ENTREPRENEURIAL SKILLS IN BASIC SCIENCE EDUCATION FOR JOB CREATION IN NIGERIA**

*Maryrose C. Mbanefo, Obiajulu C. Eboka*

*University of Nigeria, Nsukka, Nigeria*

Innovative and entrepreneurship skill acquisition in Nigeria entails focusing on what should be done to bridge the gap between the school and labour market, where the learner will work on graduation, so as to be self-reliant in the society. This study examined the extent Innovative and Entrepreneurial Skills are integrated into the Basic Science Education in order for the students to be equipped with the basic skills, knowledge and attitude for job creation. Specifically, it determined: the innovative and entrepreneurship skills needed in Basic Science Education for job creation; the teaching strategies required for the acquisition of innovative and entrepreneurship skills in Basic Science; and the factors that pose challenges to the acquisition of Innovative and Entrepreneurial Skills in Basic Science students for job creation. The study was carried out in Delta State of Nigeria and was guided by three research questions. Descriptive survey research design was adopted. The population of the study was made up of principals and Basic Science teachers in the Junior secondary schools. Two instruments used for data collection were: a 22- item questionnaire and unstructured interview guide. Mean and standard deviation were the descriptive statistics used to answer the three research questions, while t-test was used to test the null hypothesis at 0.05 level of significance. The findings revealed that a lot of innovative and entrepreneurship skills are needed in science education for job creation and the teachers are required to use practically oriented methods in teaching the students. It was also revealed that lots of factors pose challenges to the acquisition of entrepreneurship skills in Basic Science Education. Consequently, the study recommended that; the scope of the curriculum should be extended to have more entrepreneurial subjects; the government should provide funds for infrastructural facilities and equipment that are needed for creativity and innovation, and help to develop teachers' capacity in content and pedagogical skills by regular training.

## **EFFECTIVE TEACHING AND LEARNING IN SCIENCE EDUCATION THROUGH INFORMATION AND COMMUNICATION TECHNOLOGY (ICT)**

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This paper takes a cursory look at the application of information and communication technology (ICT) in science education; which is the study of biology, chemistry or physics in conjunction with education in other to be able to teach science concepts and address students' misconception in science. Many science education teachers need to bring ICT knowledge up to date since ICT tools are considered to be an efficient way to handle the horizons of traditional science education teaching. The paper reviewed various applications if ICT in effective teaching and learning of biology education, chemistry education and physics education; problem militating against full application of ICT in science education was highlighted as well as the prospects of ICT in science education. Some solutions to these problems were also suggested.

## STEM FOR LIFE: 21<sup>ST</sup> CENTURY SKILLS

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The 21st century dawned as the beginning of the Digital Age because of unprecented growth in technology and its subsequent information explosion. Besides, new technologies and tools multiply daily and the new technologies of today are outdated almost as soon as they reach the market. Therefore in a technology-mediated world, students should not only possess skills in areas such as mathematics, science and language arts, but they must also be equipped with critical thinking, problem-solving, collaboration, information literacy, creativity and curiosity skills (Schwab, 2015, Jerald, 2009).

Numerous studies and reports have emerged over the past decade that seek to identify the life, career, and learning skills that define the skills needed for success in the 21st century world. While there are some differences in how the skills are categorized or interpreted, but also many commonalities.

Common skills can be categorized as

- Creativity and Innovation
- Critical Thinking and
- Problem Solving
- Information Management / Information Literacy
- Effective Use of Technology
- Career and Life Skills
- Cultural Awareness

These skills are about the core skills for life and students will use as they learn subject area content and work with others to deepen their understanding of the content (Jukes, McCain, & Lee, 2010). Through those skills students will be able

- to see how what they are learning connects with their lives and the world around them,
- to use the content knowledge in new ways and to extend their understanding through collaboration with others,
- to have deep understanding of the learning by focusing on projects and problems that require students,
- to use technology in order to access, analyze, organize and share what they are learning
- to solve complex problems that require higher order thinking and application of content and that result in new perspectives and solutions to problems.
- to work collaborative as they gather information, solve problems, share ideas, and generate new ideas.
- To develop life and career skills by creating opportunities for students to become

self-directed learners who take responsibility for their own learning and who learn how to work effectively with others.

- To help students make connections between subjects, concepts and ideas and with others, including those outside of the classroom.

How Should We Prepare Students for Success in the 21st Century? How Should Learning Environment Prepare Students for Success in the 21st Century? In this paper answers of the questions will be discussed.

### References

- Jerald, C. D. (2009). Defining a 21st century education. Center for Public Education.
- Jukes, I., McCain, T. & Lee C. (2010). Understanding the Digital Generation: Teaching and Learning in the New Digital Landscape. Kelowna, BC: 21st Century Fluency Project.
- Schwab, K. (2015). The Global Competitiveness Report 2015-2016. World Economic Forum 2015.

## **ARE DIGITAL TECHNOLOGIES USED TO REPLACE ESTABLISHED TEACHING PRACTICES AND APPROACHES OR ARE THEY BEING USED TO INNOVATE?**

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### Introduction

This case study reflects on the use of digital technologies within a blended learning context in two different settings: the UK which has a well-established tradition of online and distance learning and Uruguay where use of technology for learning is a more recent innovation. This research presents findings from a project initiated by the British Council to provide support and advice for STEM education in Uruguay. The project involved a series of workshops for those developing a new blended learning curriculum for teacher education and training in Uruguay. This was a unique opportunity for collaboration between teacher educators and it provided an opportunity to reflect on the similarities and differences between the uses of digital technologies for learning. Are digital technologies used to replicate established teaching practices and approaches or are they being used to innovate? How do emergent new practices make creative use of the features of digital technology and harness these for learning?

### Background

Online and blended learning have long been accepted as good solutions to the challenge of learning at a distance and opening up access to education. Blended learning is characterised here as learning programmes where the majority of the curriculum content is delivered online using digital tools and this is supplemented with some face to face training days. The UK and Ireland already have a strong track record in training teachers using a blended learning model and have used it successfully to help alleviate the shortage of teachers in some subjects. One of the authors has been innovating in teacher education and training using this approach in the UK and Ireland for the past 10 years. In Uruguay they are beginning to make use of blended learning in an ad hoc way and have access to a Schoology virtual learning environment. They are now in the process of developing a new blended learning programme for teacher training to help improve standards and access to teacher training.

Unusually access to technology is not an issue in Uruguay; fibre optic broadband is available throughout the country and plan Ceibal ensures every pupil has their own computer. In comparison access to fast broadband is still an issue for many in the UK and Ireland. Most teacher training in Uruguay already makes use of distance learning but they are largely working in isolating developing their own methods for distance learning. In the UK there is a huge variety of modes of delivery and curriculum but usually the curriculum and modes of delivery are institutionally defined so not all tutors have the opportunity to innovate.

### Methodology and Data

A qualitative case study methodology was used. The workshops involved a set of collaborative activities designed to explore uses of technology and the purposes, elements and con-



struction of a curriculum into a coherent whole.

Data sources included workshops plans and PowerPoint presentations, recordings of the reflections made by the two visitors after the end of each day, field notes of oral inputs made by the Uruguayan collaborators, transcriptions of discussions, summary notes from discussions made in front of the group members on boards recorded as digital images, summary document of outcomes which was shared with all.

The work presented here is from the first phase. The authors are the two visitors from Ireland and England.

### Conclusions

Some common themes emerged from our study of teacher educators' use of digital technologies on their blended learning programmes. In both settings a variety of digital tools were being used to deliver learning content, communicate and support students, provide feedback and to facilitate assessment. However, although digital tools were being used in instruction and activities in both settings, some of the uses were relatively trivial e.g using the computer as word processor or a calculator and often technology was yet to be embedded in practice. Teachers and teacher educators had a tendency to use digital tools to replicate the face to face environment rather than innovate and do what could not be done before by using the strengths of the new technologies to enhance learning.

In Uruguay teacher educators essentially work in isolation or in small groups and have to develop their own materials and syllabi. They had much less central advice on what to teach and how to teach it than their UK counterparts. Despite this and having much less time and exposure to new pedagogies emerging from the digital environment some of the teachers in Uruguay demonstrated truly innovative and creative uses of technology to support learning. Which raised the question does isolation and independence breed innovation?

## USING CUTTING EDGE ANATOMAGE TECHNOLOGY IN THE STUDY OF HUMAN ANATOMY

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For most students entering allied health professions, studying actual human anatomy is preferred over learning human anatomy by studying the anatomy of cats, pigs, sheep, and other mammals. The dissection of human cadavers would be ideal for most health students, but may not be practical for many small institutions. The Anatomage provides a useful alternative or even supplementation to using ordinary human cadavers by providing students with a dynamic, interactive dissection experience of life-size anatomy using a three-dimensional (3D) cadaver visualization table. The visualization table harnesses cutting edge technology providing students with the ability to study both normal and abnormal anatomy of human cadavers without the chemicals, costly cadaver labs, recurring purchasing costs, and facility and ventilation problems. It allows students to understand 3D relationships of organs and organs systems in ways that static images, like those in textbooks cannot. With the Anatomage students can undo and redo cadaver dissections again and again.

## **ASSESSMENT OF THE PROFESSIONAL DEVELOPMENT OF SCIENCE TEACHERS : IMPLICATIONS FOR QUALITY ASSURANCE IN SECONDARY SCIENCE EDUCATION**

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Professional Development is vital for science teachers with the continuous growth of scientific and technological innovations. The role of qualitative science education in fostering sustained economic growth, global competitiveness and improved quality of lives cannot be overemphasized. The study examined the professional development of science teachers and its implications for quality assurance in secondary science education. The focus of the study was to find out specifically previous training programmes science teachers have been engaged in, their professional development training needs and the challenges to science teacher's professional development. The study was carried out in Delta State in Nigeria. Three research questions guided the study. A descriptive survey research design was adopted in the study. The population of the study was three hundred and sixty (360) science teachers in twenty-two (22) public secondary schools in Oshimili North and South Local Government Areas in Delta State. The sample of the study was made up of one hundred and twenty (170) science teachers in twelve (12) public secondary schools selected using the stratified simple random sampling technique. The instrument for data collection was a 24-item structured questionnaire. The simple descriptive statistics of mean, standard deviation and percentage was employed in data analysis. The findings revealed that most science teachers engage in informal dialogue with their colleagues on how to improve their teaching and went through a qualification programme while some read professional literature. Secondly, the professional training needs of science teachers ranged from the need for innovative and entrepreneurship skills, competence in subject area, student's assessment practices and instructional methodology amongst others. Finally, the third finding revealed the inability of Government to provide sponsorship for science teacher's professional development as the major challenge confronting their professional development. Based on these findings, recommendations were made in the study.

## **THE EFFECTIVENESS OF PROBLEM-BASED LEARNING ON QATARI STUDENTS' ACADEMIC ACHIEVEMENT AND PROBLEM-SOLVING SKILLS IN BIOLOGY**

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**Abstract.** This study aimed at comparing the effectiveness of problem-based learning (PBL) and traditional instruction on 12th grade students' Problem Solving Skills (PSS) and academic achievement in Biology unit on Genetics and Inheritance. For this purpose, four classes with a total of 76 students were randomly assigned as experimental and control groups. The experimental group students were taught the subject using PBL approach, while the control group students underwent traditional Biology instruction. Quasi experiment with non-equivalent control group, and pretest and posttest design was used for this study. Solving Problem Scale (SPS) was used to measure the PSS and achievement test was used to measure students' academic achievement. Multivariate Analysis of Covariance results showed that the PBL students had higher SPS and achievement scores improvement when compared with their counterparts in the control group. This indicated that the PBL students appeared to be better compared to the conventional students in terms of PSS and academic achievement. The implication of the study suggested that PBL is effective in improving students' PSS and academic achievement in Qatari schools.

## **ASSESSING TEACHER CANDIDATES' OPINIONS ON SUSTAINABLE FOOD CONSUMPTION IN THE CONTEXT OF EDUCATION FOR SUSTAINABLE DEVELOPMENT**

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Education has been considered among the significant paths to attain the goals of sustainable development, and combat with the adverse consequences of the unsustainable human activities (Global Sustainable Development Report, 2015). United Nations (UN) stated the definition of Education for Sustainable Development (ESD) “aims to help people to develop the attitudes, skills, perspectives and knowledge to make informed decisions and act upon them for the benefit of themselves and others, now and in the future. ESD helps the citizens of the world to learn their way to a more sustainable future.” Considering the definition of ESD, it has been emphasized that ESD centralizes around various issues dealing with sustainability such as climate change, biodiversity, population growth, consumption patterns, etc. (UN, 2012). ‘Sustainable diets’ has attracted attentions within the issue of sustainable consumption and production patterns which emerged starting from the 1970s among the stated environmental problems and international agreements. While the food system faces various sustainable challenges in the modern World, food consumption in developed countries has critical consequences from a standpoint of environment society, culture and economy (Reisch, Eberle, & Lorek, 2013; Vinnari & Tapio, 2012). In fact, if current population and unsustainable consumption patterns goes like that, the equivalent of two Earths is required to support humanity by 2030 (Global Footprint Network, 2012). United Nations Environment Program (2012) has recently reported the critical role of global food consumption patterns in achieving sustainable food systems. In addition to food-related problems experienced in developed countries, serious issues covering hunger and malnutrition could be also observed in undeveloped and developing countries. According to UNESCO (2009) food crisis and world hunger are critical problems linked to unsustainable consumption and production systems. These unsustainable patterns impacts environment not only for present and future generations but also sustainable living on our planet.

Teacher education is crucially important for the international community because these individuals are vital in educational process, especially in ESD (UNESCO, 2010). Teacher education seeks to increase awareness of sustainable development and improve the required competences (The European Training Foundation, 2011, p.17). In fact, pre-service teacher training is one of the most appropriate stage to educate teachers and the best way of ensuring sustainable development of environmental education (UNESCO, 1987). In this aspect, the present study aimed to share the draft version of a measuring tool assessing teacher candidates' opinions on sustainable food consumption and portray the current state of the teacher candidates at a public university in Turkey.

## **TURKEY'S AMBITION ON SCIENCE CENTRES: EXPLAINERS' AND TEACHERS' VIEWS ON THEIR OWN PROFESSIONAL DEVELOPMENT**

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In recent years, Turkey has invested a large amount of money to enhance public engagement with science and technology. The Scientific and Technological Research Council of Turkey (TÜBİTAK), in cooperation with local authorities, has been establishing science centres around the country, aiming to complete a science centre in all 16 metropolitan areas by 2016, and in all 81 cities by 2023. The infrastructure and well-training staff among others are both important for establishing an effective science centres. Nonetheless, the resources and training of explainers have been overlooked. Besides, lack of studies in teachers' awareness on the effective use of resources in science centres' in relation to the implementation of science curriculum in their classrooms was seen main obstacles. In order to overcome such shortcomings, "educating teachers and explainers of science centres" BİLMER project was developed. The BİLMER project, supported by TÜBİTAK (project no: 114K646), aims to develop a model of professional development (PD) for teachers and explainers of science centres.

In this study, theoretical framework of this PD program and implementation strategies will be briefly mentioned and then explainer's and teacher's views on the tentative BİLMER professional development programs will be compared and evaluated. There are nine strands in BİLMER PD Model: science communication, learning in science centres, theories of out-of-school learning, nature of science, discourse analysis, developing science shows, developing learning sequences, teaching and learning activities in science centres, developing classroom materials and integrating them with science centres visits. Data were obtained from BİLMER pilot workshop by using an open-ended questionnaire and researchers' observation notes. 25 teachers and 14 explainers participated in the workshop. The data were analysed by a qualitative approach. Findings indicate that teachers and explainers have similar expectations nonetheless they have quite different priorities. For example, both teachers and explainers have pointed out that they need theoretical knowledge and some sample activities related to nature of science nonetheless only explainers expressed that they need training on science communication. Both groups of teachers and explainers reported the importance of collaborations among other science centres, universities and schools. The results shed lights on Turkey's ambition on making future science centres and the improvement of the quality of science communication accordingly.

## PSYCHOLOGICAL FACTORS AND SECONDARY SCHOOL STUDENTS' ACADEMIC PERFORMANCE IN MATHEMATICS

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This study was designed to predict students' academic performance in mathematics at the thinking level from students' psychological factors (Self-concept, test anxiety, interest in schooling, attitude towards mathematics, motivation and locus of control) and performance at the lower cognitive levels (knowledge and understanding levels). The survey made use of a simple random sample of three hundred (300) senior secondary two (S.S.2) students from six secondary schools in Calabar Metropolis of Cross River State, Nigeria. The students responded to two valid instruments: Students' psychological variables rating scale; and Mathematics achievement test. The students' psychological variables rating scale comprised of 40 questions which measured six variables, while the mathematics tests consisted of 60 questions which measured students' performance at three cognitive levels. Data analysis involved the use of multiple regression analysis. Results showed that students' psychological factors and students' achievement at knowledge and understanding levels are significant joint predictors of senior secondary students' performance in mathematics at the thinking level, and that such prediction could be done using the equation: Students' performance in mathematics (thinking) =  $1.859 + 0.01(\text{interest}) + 0.021(\text{attitude}) - 0.041(\text{Motivation}) - 0.044(\text{Self-concept}) + 0.072(\text{Test anxiety}) - 0.041(\text{Locus of control}) + 0.186(\text{ Knowledge}) + 0.296(\text{ Understanding})$ . It was observed that students' performance at the understanding level is the strongest predictor of their performance at the thinking level followed by performance at the knowledge level. It was therefore concluded that certain factors within the individual learner and level of success at lower cognitive level is responsible for future learning even at a higher cognitive level.

## THE VIEWS OF STUDENTS AND TEAM COACHES ABOUT ROBOTIC COMPETITIONS (THE CASE OF FIRST LEGO LEAGUE)

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In many surveys, the effect of Legos on students' success and their ability to solve problems has been examined since 1998. As a result of the practices such as robot layouts, robot competitions and robot projects in science and technology education, it has been observed that students has gained many abilities like solving problems, finding practical solutions to the problems, critical thinking, getting aware of their own skills, getting experienced from first-hand and using technology. In addition to this, teaching science lesson with Legos contribute to cognitive process skills and sense of self in a positive way.

First Lego League (FLL), which has been in progress internationally since 1999, has been organized in Ankara, İzmir and İstanbul in Turkey since 2002 in the name of "Bilim Kahramanları Buluşuyor". Up to now, a great amount of students, families and team coaches has been interested in this competition. it is thought that determining the experiences of students and team coaches attending the international competition and their views about robotic projects, process of making project, motivations towards cognitive studies, experiences and team work in one season will guide the labors in that field and also fulfill the deficiencies in that field.

The aim of this work is to determine the students' and team coaches' competition process who attended First Lego League/ "Bilim Kahramanları Buluşuyor" and also their views about robot design, programming, attitudes towards scientific topics and collaboration. In the survey, case study model is used among the qualitative research models. The layout group of the work is consisting of fifteen students and three coaches who has attended in First Lego League/ "Bilim Kahramanları Buluşuyor" in Ankara. The schools in which students continue their education and team coaches work, state in Ankara. In the work, interview method is used among the qualitative information gathering methods. In order to determine the views, half-structured interview form consisted of six questions is used. This form has been examined by a science teacher and an evaluation expert to determine the validity of the test. The questions have been practiced to three students and a team coach. From the feedbacks of this practice, the last format has been decided. The information gathered from the work has been examined by content analyzing to identify the views and the manners of the participants. To make sure of the reliability of the work, a science expert and a science teacher has analyzed it. By comparing the latest decoding, the Miles and Huberman percentage is calculated %95,20 for students and %90 for team coaches. Thanks to interviews with students, it is determined that robot kits are funny and functional, attractive, motivative for students and also increase the students' interest towards scientific researches. Besides team coaches' views are parallel with the students', they state not only the competition process has some criteria which are not explicit but also the tournament should be used a token for marketing of Legos.



## **ASSESSMENT OF THE CHALLENGES LIMITING THE USE OF INFORMATION AND COMMUNICATIONS TECHNOLOGY TOOLS IN TEACHING AND LEARNING IN TERTIARY INSTITUTIONS IN SOUTH-SOUTH NIGERIA**

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The aim of the study was to identify and assess the challenges limiting the use of Information and Communications Technology (ICT) tools in teaching and learning in Universities in the South-South zone of Nigeria. The study was a survey design employing the use of questionnaire to elicit responses from the subjects. The population for the study consists of academic staff in the 25 in the six states in the zone. Five research questions and two hypotheses were raised to guide the study. Data collected were analysed using descriptive statistics and chi-square. Results of data analysis showed that

- 1 there is low level of computer literacy among senior academic staff in public and private Universities in the South-South zone of Nigeria.
- 2 most academic staff lack the skills required to manipulate ICT tools needed for teaching and learning in the public and private Universities in the South-South zone of Nigeria.
- 3 computer hardware and accessories as well as Internet access are in short supply in state universities than Federal and private Universities
- 4 challenges associated with lack of hardware and accessories appears to rank higher than other challenges limiting the use of ICT tools in teaching and learning in the South-South zone of Nigeria.

The study recommend that proprietors should improve on the installation of computer hardware and accessories in Universities. In-service programmes should be organised for senior academic staff to boost their computer literacy level and competencies in the use of ICT tools in teaching and learning.

## COLLABORATIVE WEB-BASED LEARNING THROUGH LESSON STUDY: PROFESSIONAL DEVELOPMENT OF SCIENCE EDUCATORS

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In the past two decades, different characteristics have been observed between experienced and inexperienced science teachers with the aid of visual resources. In Japan, teachers have conducted science classes in every school, but in general, exceptionally good classes, particularly those of virtuoso teachers, are discussed only within the local context. The teachers' conference in a school is called "zyugyo-kenkyu" in Japanese, which translates to 'lesson study' in English. The increased effectiveness of a lesson study on professional development has been ubiquitously reported in different countries and contexts.

However, lesson study (1) is normally time constrained and space dependent, (2) poses difficulty in conducting parallel and asynchronous video studies, and (3) seems inefficient in engaging educators in collaborative participation. Lessons are so complicated and irreversible that research on the relationship between the cognitive level of teachers' questions and the achievement of their students has proved frustrating to many in the field of education. Sociolinguistic studies provide a way of describing the context of the subject matter; however, they require a large investment of time, considerable subject-matter knowledge, and complex analyses. In an actual classroom setting, merely 'consuming' information leads to declarative and isolated ideas. Our group developed a web-based collaborative lesson study system to address these issues and we will demonstrate the system to the participants of this workshop.

In this system, all comments on a lesson and the date and time stamp are automatically logged into an Excel database. Each comment can be submitted asynchronously and seen in real time. Each participant can comment on others' comments. This means that registered users can join the lesson study on the web anytime and anywhere. The administrator of the system can upload video files for the science lessons. This web-based collaborative lesson study system was developed to allow educators to concurrently be able to (1) watch educational practices and leave comments, (2) carry out real-time discussions, and (3) reflect on and analyse the comments. Actual classroom-based teaching produces 'noise' that needs to be dealt with repeatedly. This system is a powerful tool that aids follow-up observations and leads to the development of skills for discerning what appears to be visible and noticing salient points. Moreover, the web-based system offers greater potential to support teacher education. It would be also appropriate and significant to use this system to compare teachers' views and understanding of science lessons before and after the teacher training programmes. Teaching practices and the experiences of experienced and inexperienced teachers can also be compared using this system. Finally, we can use this system to investigate the effect of collaboration on teachers in improving their science lessons. Science lessons are often discussed in the local context, but the discussion would be more fruitful if it traverses cultural borders.

## CREATIVE SCIENCE WORKSHOP FOR EARLY CHILDHOOD LEARNING

*Janchai Yingprayoon, Dee Jean Ong*  
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Research shows that a child's mental growth is most rapid before age of 12. It is recognized that hands-on experience through practical work is an essential component for creativity development. The first step to do this is to arrange creative learning atmosphere so that the kids can enjoy learning how to use their 5 senses (Eyes, Ears, Nose, Tongue and Skin) to get information from things or phenomena around them in daily life. By using inquiry process, they will be stimulated to make connections from information they receive from different senses to form links in their brain for their future use. The second step is to setup an exploring atmosphere so that they can use their brains for thinking out of the box, brain storming as well as making connections of information.

The main activities in this workshop is to introduce some creative activities of using 5 senses (Eyes, Ears, Nose, Tongue and Skin) for kids to explore things or phenomena around them in daily life in a fun way. We use SCAMPER (S-Substitute, C-Combine, A-Adapt, M-Magnify/Minify, P-Put to other uses, E-Eliminate, R-Rearrange /Reverse) activities to explore things or phenomena. The workshop will show how to use sensing organs to get information from nature.

Information from various sensing organs:

Eyes-Classification of things and animals, Color, shape, numbers, places, etc.,

Ears: Animal sounds, Sound in nature, languages, music, etc.,

Nose: Smelling from different sources like flowers etc.

Tongue: Taste of food and drink like orange, sugar, salt, etc.

Skin: Shape, surface and temperature

With these activities, we also introduce method of observation, arousing curiosity as well as using sense of humor and amusing toys in a fun way. The kids will learn how to explore nature and how to form links of information in their brains with fun and their can remember things around them in daily life better.

## A REVIEW OF THE LABORATORY SAFETY GUIDELINES PROJECT: A SESSION WORKSHOP EXERCISE

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Even in the most safety conscious countries, incidents which can cause (sometimes serious) injury to students and teachers, happen. It is simple to blame the materials or the equipment. This has resulted in bans on the said materials and equipment which have usually been previously used, safely, millions of times before by teachers. Unnecessary, knee-jerk bans can seriously curtail practical work. Usually, in school science and industrial accidents, the faults lie with both the person (failure to follow safe procedures) and with senior management (eg, failure to monitor and train teachers). Would we ban the motor car because someone has had an accident?

One of the proposed projects on the ICASE website (<http://icaseonline.net/safety.html>) is to produce basic laboratory safety guidelines. We need to remember that not all schools have laboratories but use work rooms. So it would be better phrased as Essential School Safety Guidelines for Practical Science or similar. The guidelines should not reflect the safety of just one nation but be generic to all nations. The idea that schools should “Conduct periodic, un-announced laboratory inspections to identify and correct hazardous conditions and unsafe practices. Involve students and employees in simulated OSHA inspections” as a whole would not be relevant to schools in other countries but the USA. However, a guideline that senior management should monitor the activities of the staff and require the regular inspection of equipment, the work rooms and staff behaviour would be entirely sensible.

The guidelines should not go into fine detail such as acids and alkalis should not be stored together, which is a sensible requirement in industry where tonnes and cubic metres of reagents are stored. Many schools in the world would not even have separate rooms for this. However, cupboards and rooms should be kept locked when not occupied. Theft and arson are greater risks; security of materials and equipment is an essential guideline. The guidelines could now require that all bottles containing a substance deemed to be hazardous should be labelled according to the UN Global Harmonised System and labels should be in a language common to the users of that material. It would not be sensible to have a chemical labelled in Chinese, in a school in Europe!

Recommended sources of information (if used) should be very general.

The object of the meeting, using the expertise of delegates attending and information from various countries, would be to produce a 1 to 3 page document (the shorter the better) of basic statements of safe practice in school practical work. It would be the intention that this document would serve as a frame work upon which countries requiring practical work in their science syllabus, could use to instigate a safety policy.

A proposed starting point would be a division into 4 sections.

1 Basic safety guidelines for students in the room

Most schools will have a list of rules (I hope) but it needs to be supported by teachers, senior

management and employers setting a good example. An example would be there should be no eating, drinking and application of cosmetics should be a fundamental guideline,

## 2 Minimum safety guidelines for teachers and assistants in science

Teachers have a duty of care to their students. (Duty of care is a legal phrase in the UK, is it the same in every country?) Teachers should set good examples to students by wearing eye protection and being aware of any risks that might occur in materials and chemicals used in a science practical lessons. Teachers should be able to apply immediate remedial measures in case of an incident. The availability of trained first aid staff may well be different in every country. How can safety in open-ended work be scrutinised?

## 3 Minimum safe storage and room provision for science.

A water supply is essential in a science work room but a shower is not. The mains electrical supply should be safe etc.

## 4 Monitoring and inspection for senior management and employers

In UK law, the employer has a duty of care in the safety of their employees. Is this true in all countries? In this respect, the employer should monitor the behaviour of teachers in safety, encourage training when required and carry out room inspections of the facilities. All this is to ensure that the students in their care are safe but hopefully enjoying science and in particular, practical work.

## USING LOW-COST SCIENCE TOYS TO TEACH SCHOOL SCIENCE

*Janchai Yingprayoon, Dee Jean Ong*  
*Suan Sunandha Rajabhat University, Thailand*

Although science is often called as a practical subject, it is often taught without any activity in the classrooms of many developing countries. The main culprit being the lack of resources. In order to overcome this problem a low cost laboratory programme has been designed. An important aspect of this low cost experimentation is related to making of science toys. They are made using either throw away or easy available material. As a result, every child can get engaged in activity and make one for himself/herself. In doing so they learn the principles of science involved.

## **THE EFFECT OF INQUIRY BASED SCIENCE EDUCATION ON THE STUDENTS' SCIENCE PROCESS SKILLS**

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The aim of this study is to examine the effects of inquiry based learning method on students' science process skills. The sample includes 48 students from the department of Elementary Mathematics, Buca Education Faculty, Dokuz Eylül University. The study was carried out for 4 weeks in the context of General Physics 2 course. As quasi experimental design, "pretest-posttest non-equivalent control group" was used and there were one experimental group and one control group in this study. Traditional teaching method was applied to the control group whereas inquiry based teaching method was applied to the experimental group. The efficiency of the method was assessed by comparing the scores students got from sub-dimensions of Science Process Skills Scale before and after the implementation and total scores students got from this scale.

## **ATTITUDE OF UNDERGRADUATE STUDENTS TOWARDS ENTREPRENEURIAL STUDIES IN UNIVERSITY OF CALABAR, CALABAR, NIGERIA**

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This study was designed to investigate the attitude of students towards entrepreneurial studies in the University of Calabar, Calabar, Nigeria. Using the ex-post facto research design, data was gathered from a stratified random sample of two hundred and twenty-five out of a total population of 20193 undergraduate students during the 2013/2014 academic session. The fifteen item, four - point Likert type of questionnaire designed and validated for the researchers had a split-half reliability estimate of 0.86. Data gathered showed that undergraduate have a significantly high attitude towards entrepreneurial studies. It was thus concluded that entrepreneurial studies in Nigeria will thrive since students are positively posed to studying it.



## **EVALUATION OF PRESERVICE SCIENCE TEACHERS' VIEWS TOWARDS RESPONSIBLE RESEARCH AND INNOVATION**

*Bülent Cavas, Cagla Bulut*

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European Union has been putting emphasis on sharing of scientific process and recently developed technological products in a manner that society would comprehend clearly. Thus, policies with regard to creating effective interaction mechanism between scientists and society are considered to be essential. It is anticipated that a dynamic cooperation and enhanced dialogue of science and society can be provided and more scientifically literate individuals can be integrated to societies by the help of these policies. By this purpose, European Commission aimed to create strong connections between science and European society within the context of Responsible Research and Innovation (RRI) approach. Examining of this approach in training teachers and finding out preservice teachers' views toward the approach are essential. Therefore, in this study a survey was developed regarding the dimensions of RRI and carried out for 270 preservice science teachers studying at 5 different universities in the Aegean Region of Turkey. Data obtained were analyzed by using SPSS statistics program and participants' views were commented to the extent grouped themes whose items were estimated. According to data obtained it was revealed that preservice science teachers had positive views towards RRI and they can easily adapt to RRI approach.

## SCALING UP AN IMVT SCIENCE LEARNING MODEL AS AN EFFORT OF GLOBALIZATION IN CHINA

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Globalization and the evolution of the knowledge-based economy can lead to local education changes. On the other hand, local education changes might also inform global education reform when the experience can solve international issues in education. Glocalization, a portmanteau of globalization and localization, is the adaptation of international products around the particularities of a local culture in which they are sold in the business world. For education, global innovations should also fit local cultural and situation in order to benefit local needs. In this study, an iMVT (Modeling and Visualization Technology integrated inquiry-based Science Learning) innovation that was invented based on science and technology research projects in classroom in the US and Singapore was introduced to China. This is considered part of an scaling up effort, which extended the iMVT innovation to new education system. The following questions were explored: 1) How do local stakeholders understand an iMVT innovation? 2) how do local stakeholders understand iMVT fitness to local situation? and 3) how to reconcile the adaptability issue when scaling up a global iMVT innovation to China's local schools?

Two globalization models were tried in our study. Model one involved one provincial level curriculum expert and a senior school geology teacher. Good progress was made after about a year's efforts. Model two involved a group of pre-service chemistry, physics, or biology teachers who went to schools in different provinces for their teaching practicum. A workshop was given by a returning Chinese scholar who invented the iMVT science learning model to the student teachers. Pre-interview before the workshop and post-interviews were conducted after their three months teaching practicum. The interview included questions in regard to 1) Background information of pre-service teachers; 2) ideas about curricula; 3) understanding of iMVT; 4) impact factors of ICT on student learning; 5) suggestions on how the iMVT innovation might be adopted to fit local needs. Some process data were collected via a social media platform called QQ during their teaching practicum. Data were analyzed in regard to the three research questions.

Results revealed that there needed new efforts to first introduce the global innovation in local language, there involved paradigm change when local teachers and pre-service teachers adopted the iMVT science learning model. A systematic consideration is needed for glocalizing the iMVT innovation to Chinese school system.

## DRAMA FOR INCLUSION IN SCIENCE

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Role plays are claimed to improve learning of concepts, understanding the nature of science (Ødegaard, 2001).

It is relatively rare, if at all, to read accounts of the contribution of those other than eminent scientists who have made their contribution to scientific discovery. Since their accounts are not recorded it is as though they did not exist. Dramatic licence afforded by the construction of plays provides opportunities to imagine what these inputs could have been, without necessarily implying historical accuracy. This paper provides an example of an input that is plausible and credible, involving a carpenter and a stonemason.

### Context of the drama

Drawings of Lavoisier's laboratory provide many indications that it was not the work of one person, given its complexity. The Chemical Revolution of the late 18th century was based on Antoine-Laurent Lavoisier's new understanding of the chemical role of a gas —oxygen— in explaining combustion, respiration, and metallurgical processes like smelting. Lavoisier required a pneumatic trough to contain the gases he worked with, using mercury as the containing liquid since many of the gases were soluble in water. Lavoisier invited an artisan (carpenter) to build a trough from wood and filled it with mercury. In the morning, he found that the mercury had leaked out during the night as the wood contracted opening the joints. He found another artisan (a stonemason) to make one from marble, and this did the trick. The play tells the story from the point of view of the carpenter, and incorporates history and philosophy into its telling.

### The drama

The carpenter and the stonemason: their contribution to 18th century chemistry discovery.

### Actors

Jacques Cabinet: an expert cabinet-maker who provided wooden components for the Lavoisier laboratory. He was a permanent employee of the Lavoisier family and a trusted artisan.

Robert Graves: an expert stone-mason who constructed cemetery headstones, marble coffins, and carved ornate stone furniture for the outside of buildings such as churches. He was not a permanent employee but did work from time to time on special projects

Marie Lavoisier: wife of Antoine, an expert translator French-English, and eventually a chemist of some significance, having been taught by one of Antoine's students

Antoine Lavoisier: husband of Marie, tax collector, eminent chemistry researcher and government expert in matters such as gunpowder quality.

Guidance on appropriate pedagogy that involves every individual in activity are provided in the full paper.

### Conclusion

The paper provides an integrated approach to using historical evidence combined with plausible fictional dialogue to promote promotion of the contributions of artisans in the process of scientific discovery.

### Reference

- Ødegaard M 2001, Unpublished Dr. scient., Dissertation, University of Oslo.

## **ASSESSMENT OF LEARNING ACTIVITIES FOR FOSTERING CREATIVITY IN SENIOR SECONDARY SCHOOL PHYSICS STUDENTS**

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The goal of science education among others is to educate students to be able to adapt to different conditions, be flexible thinkers, ask questions, be creative and even think critically (Aktamis & Yerice, 2010). This is why Liliyasi (2007) opined that students need to master critical thinking and creative thinking skills since it can be used to protect themselves and others as well as for making important everyday lives decisions. Creativity according to Ripple (1999), is believed to be a combination of abilities, skills, motivation, attitudes and other factors. Plucker and Runco (1999) also believe that techniques for enhancing creativity involved divergent thinking and general problem solving heuristics. Creativity is not only the ability to come up with new ideas but also narrowing down those ideas to focus on one that can be elaborated (Ndirika & Agommuoh, 2014). . Physics which is one of the sciences is highly needed for our nation's technological breakthrough and advancement. Physics plays very important role in scientific and technological advancement that affects the lives of mankind and should therefore be taught properly by the teacher helping the students identify learning activities that can foster creativity in them. The purpose of this research is to investigate senior secondary school students' assessment of learning activities that can foster creativity in physics students. In order to do this, two hundred and forty (240) senior secondary school two (SSS2) physics students from four coeducational schools in Umuahia North Local Government Area of Umuahia Educational Zone of Abia State of Nigeria was used for the study. Most specifically the research questions were: 1. What are the mean scores of senior secondary school physics students on the assessment of learning activities that can foster creativity in physics students? 2. What are the mean scores of male and female senior secondary school physics students on the assessment of learning activities that can foster creativity in physics students?

## DESIGN-BASED SCIENCE LEARNING APPROACH: EXPLORING STUDENTS' COLLABORATIVE PROBLEM- SOLVING

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It is generally agreed that the main emphasis in education should be given to the development of students' creativity, critical thinking, problem solving, and collaboration skills in order to be able to respond to the current and future labour market needs (Partnership for 21st Century Skills, 2006; Binkley, et al., 2010; etc.). Design-based science learning (DBSL) is a pedagogical approach that combines the processes of engineering design with scientific inquiry attempting to engage students in scientific reasoning through solving authentic problems (Mehalik, et al., 2008; Apedoe & Schunn, 2013; Autor2, et al., 2015). It provides excellent opportunities for students to express their creative and critical thinking when developing collaboratively their own artefacts and solutions. It is expected that authentic design task acts as a trigger for learning science making students therefore feel the need to expand their science knowledge in order to be able to solve a given problem (Hmelo, et al., 2000).

In this case study, 8th grade students' (N=24) collaborative problem-solving processes were studied while implementing the DBSL approach. Three DBSL modules were developed by the research team: "Designing an ice-cream machine", "Designing a soda machine" and "Designing a potato battery". Within these modules students were expected to design artefacts from simple and easily available materials.

The aim of this study was to find out:

- (1) how science knowledge learned before or during the inquiry session within a DBSL module was transferred to and applied in a design situation;
- (2) what are the characteristics of students' scientific reasoning while solving different types of problems in DBSL setting;
- (3) what kinds of peer interactions can be observed during DBSL activities?

Data were gathered by video recorded classroom observations and students' written reports. Written transcripts of classroom discourse were analyzed interpretively using qualitative content analysis approach. Data analysis is expected to be finalised by April, 2016. The findings from this study have potential to improve our understanding of how students construct knowledge while solving complex problems in DBSL setting but also provide practical guidelines for teachers to facilitate further adoption of DBSL in science classroom.

### References

- Apedoe, X. & Schunn, C. D. (2013). Strategies for success: Uncovering what makes students successful in design and learning. *Instructional Science*, 41, 773-791.
- Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., & Rumble, M. (2010). Draft white

- paper 1 Defining 21st century skills. Retrieved from <http://atc21s.org/wp-content/uploads/2011/11/1-Defining-21st-Century-Skills.pdf>
- Hmelo, C.E., Holton, D.L., & Kolodner, J.L. (2000). Designing to learn about complex systems. *Journal of the Learning Sciences*, 9(3), 247 - 298.
- Mehalik, M. M., Doppelt, Y., & Schunn, C. D. (2008). Middle-school science through design-based learning versus scripted inquiry: Better overall science concept learning and equity gap reduction. *Journal of Engineering Education*, 97(1), 71–85.
- Partnership for 21st Century Skills. (2006). A state leader's action guide to 21st century skills: A new vision for education. Tucson, AZ: Partnership for 21st Century Skills.
- Author2, Author1, Rannikmäe, M., & Holbrook, J. (2015). Factors explaining gymnasium students' technology related career orientations. *Journal of Baltic Science Education*, 14(6), 706–722.

## **A NEW APPROACH TO TEACH EARTHQUAKE CONCEPT USING SSE PROJECT**

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Schools Study Earthquakes (SSE) is funded European Union Erasmus Plus Project, coordinated by National Observatory of Athens, included 6 partners from EU countries. The main aim of this Project is to promote scientific literacy at all levels but its benefits go far wider than simply providing scientific knowledge about this everyday natural phenomenon such as earthquakes. The project provides the basis for informed action to protect lives and property on local, regional, and national levels. Project also use Inquiry Based Science Education (IBSE) as main teaching and learning methodology to increase students motivation toward science courses. The SSE project and proposed approach will not only contribute to providing high-level educational material to teachers and their students but will also highlight aspects of civil protection, citizenship, civil responsibility and cooperation. The paper will describe the Project, Project outcomes, IBSE based teaching and learning materials and earthquake data collected by teachers and students in Turkey.



## **AN ASSESSMENT OF NEW SCIENCE AND TECHNOLOGY CURRICULUM IN TERMS OF LABORATORY USAGE**

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Science learning process provides students inquire phenomena both in the natural atmosphere, classroom, and laboratory. The science laboratories are more dangerous than the class environments at schools. Almost all laboratory techniques may cause injuries or to exposure a variety of risks. Young (1991), states that usually secondary school laboratory practices includes the applications performed by the students who don't have awareness about hazards of chemicals and equipment. However laboratories which provide effective and meaningful learning are important learning environment where students connect between pre and new knowledge. In this study, it is aimed to make an assessment of New Science and Technology Curriculum in Terms of Laboratory Usage for the class levels of 5th, 6th, 7th and 8th. The study mainly through by the units of a class during an academic year. Qualitative data was used which is tabulated by frequency and percentage calculation. The results show that in the level of 5th grades, %25 of the lessons are suitable for the usage of laboratory more than the classroom environment. According to the results, in the level of 6th grades, %12.5 of the lessons are suitable for the usage of laboratory while in the 7th grades, the ratio is %16 and for the 8th grades, it can be explained with %17.8. It can be understood that 5th grades use laboratories in a wider range than the other levels. As a result of interpreting the findings obtained from the research, it has been considered that the ratio of usage the laboratories at secondary schools according to the curriculum, changes between %25 and %12.5. The low rates of the laboratory usage can be explained with the lack of safety plans, safety guidelines, or a properly trained person appropriately care for lab accidents at secondary schools in Turkey.

## **EFFECTIVE APPLICATION OF FACILITATION TECHNIQUES APPROACH FOR PROMOTING CREATIVITY IN BASIC SCIENCE STUDENTS**

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The primary purposes of instructional delivery are to impart knowledge (content) and develop thinking skills such as creative thinking skills. Studies have shown that there is poor development of creativity in basic science students. This has been attributed to teaching or instructional delivery methods among other reasons. There is therefore, need for teachers to adopt effective and innovative method of teaching that will help develop creative thinking skills in basic science students. One of such methods advocated here is the use of facilitation technique approach. It is hoped that an effective application of the approach can help promote creativity in basic science students. This paper discussed facilitation technique, the facilitator, the effective application of the technique (with illustrations), as well as creative thinking skills. It was recommended that the instructional delivery approach should be adopted; teacher preparation programs should prepare teachers to use the approach, and institutions of learning should provide instructional materials for the teachers to use.

## **GRADE NINE STUDENTS' INTEREST TOWARDS SCIENCE TOPICS PRESENTED IN DIFFERENT CONTEXTS**

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Research has shown that students are motivated to learn if a context-based approach is used, striving to make the content understandable, interesting and connected with their everyday life. The main goal of the current study is to find out how the context (in which the topic is presented) influences grade 9 students' interests towards learning science and at school. The research was carried out in 2016 involving 849 students in grade 9. Based on a literature review and earlier studies carried out by the authors, Likert-scale questionnaire was developed. According to the purpose, we used only one section of the whole instrument for the current study. The section consisted of 36 items (9 in each science subject – biology, geography, chemistry and physics) with a focus on science curriculum related topics presented in three different contexts (content-related, social related and personal related). The preliminary findings show that students were most interested in science topics which were presented in personal or social context compared to content related context

## **ASSESSMENT OF EMOTIONAL INTELLIGENCE, PERCEIVED SELF-EFFICACY AND ACADEMIC ACHIEVEMENT OF SCIENCE, TECHNOLOGY AND MATHEMATICS EDUCATION STUDENTS IN JOS, NIGERIA**

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Emotional and self-regulatory processes, which are critical aspects of cognitive functioning and academic achievement, have not been a focus of research in Africa, particularly in higher education, as well as in science technology and mathematics education fields. Moreover, findings of a few studies from available literature are inconclusive. This study focuses on assessment of emotional intelligence, perceived self-efficacy and academic achievement of science technology and mathematics education (STME) students in Jos, Nigeria. The participants for the study comprise two hundred and sixty 300 level science, technology and mathematics education students of University of Jos, Nigeria, aged 18 to 30 years. Three research questions and four hypotheses will be used to facilitate the investigation while the survey research design will be adopted. The stratified sampling technique will be used to categorize participants according to emotional, intelligence, perceived self-efficacy and achievement levels in a core course, EDU 303A (Research Methods). This study is anchored on Goleman's (1995) model of emotional intelligence and Bandura's (1977) social learning theory. Emotional Intelligence Scale (EIS) and Perceived Self-efficacy Scale (PSES) will be used to collect data from participants for analysis. Students' Achievement Scores in EDU 303A will be used to categorize participants according to levels of achievement. The construct validity of the EIS and PSES will be determined through exploratory factor analysis. The internal consistencies of the instruments will be determined using the Cronbach alpha method. Research questions will be answered using frequencies, percentages and bar charts while the hypotheses will be tested using t-test, Chi square, Analysis of Variance and regression at 0.05 level of significance. Findings of the study and their implications for effective STME delivery will be discussed and recommendations made.

## **VIEWS OF TEACHERS PARTICIPATED IN PILOT WORKSHOP ON TEACHER PROFESSIONAL DEVELOPMENT TOWARDS SCIENCE CENTRES**

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Studies revealed that field trips to out of school learning environments have a positive effect on students' traits such as self-perception, self-confidence, self-efficacy, personal productivity and also improve various personal and social skills such as creativity and communication skills (Rickinson et al., 2004). However, even in developed countries, teachers could not benefit from science centers sufficiently and this may be resulted from that teachers were not offered professional development programs about how to benefit from out of school learning environments (Melber & Cox-Petersen, 2005). Whereas, many studies emphasized that professional development programs regarding science centers would provide unique opportunities and gains for teachers. The aim of this study was to investigate views of teachers on professional development program that was developed for explainers of science centers and themselves under the project of BİLMER (Trainings for teachers and explainers of science centers).

The pilot implementation of professional development (PD) program developed under the project of BİLMER was held on March 11-13, 2016 in Ankara. During three days, many workshops were conducted at different locations such as Gazi University, Middle East Technical University Science Center (METU SC), Feza Gürsey Science Center, and Observatory of Ankara University. The pilot workshop was composed of sixteen sessions and took thirty-six hours. Thirteen explainers who work at different science centers and twenty-five teachers who work at different schools and have different majors such as chemistry, physics, biology and science education participated in the pilot workshop. Also, ten academicians sometimes participated as a leader/mentor and sometimes as a participant.

Data source of this study was teachers' responses to four open-ended questions distributed at the end of the workshop. These questions, prepared by taking into consideration of aims of BİLMER Project, are:

- Which is the best, most positive and most different aspects of the pilot workshop?
- Which is the weakest, most negative aspects of the pilot workshop, and what aspects of the pilot workshop are needed to be developed?
- What should teachers do to use science centers more efficient and more productive?
- What should explainers do to use science centers more efficient and more productive?

The responses of participants were subjected to the content analysis (Strauss & Corbin, 1990). In the result of analysis, six themes were emerged, which were (1) the best and most positive aspects of the workshop, (2) the weakest and most negative aspects of the workshop, (3) the most different aspects of the workshop, (4) expectations from teachers to use science

centers efficiently, (5) expectations from explainers to use science centers efficiently, and (6) expectations from science centers to use themselves efficiently.

According to results of this study, teachers thought that they need information about science centers and science centers should also introduce themselves to teachers and their schools. Moreover, the most repeated ideas among teachers are the importance of School-Science Center, Science Center-Science Center, and School-Science Center-University collaboration and the requirement of establishing continuous communications among these institutions. Based on these results, it was concluded that teachers definitely need information about science centers before they conduct a visit to them. These information include both general information like where it is located, what programs are offered and specific information like what activities, workshops, science shows are conducted by them. Finally, teachers reported that they found some activity ideas offered in the pilot implementation of PD program quite interesting such as the idea of producing desktop versions of exhibits that are exhibited in science centers and using these exhibits developed by themselves in their classrooms. They also emphasized that they want to see more these types of implementations which also link with curriculum.

All in all, like BILMER PD program, in PD programs for teachers to make them maximize both their and their students' gains from science centers, there is need to provide information for teachers about what they should do before, during and after the field trip to science center, how they can develop a lesson plan towards field trips to science centers, which type of activities towards field trips they can conduct in their classrooms. During planning a field trip to science centers, the collaboration and cooperation between teachers and explainers of science centers can also be highlighted. Additionally, showing good practices rather than giving mostly theoretical lectures can be preferred in PD programs.

**Keywords:** Informal Learning, Science Center, Teacher Education, Professional Development, BILMER Project.

#### References

Melber, L. M., & Cox-Petersen, A. M. (2005). Teacher professional development and informal learning environments: Investigating partnerships and possibilities. *Journal of Science Teacher Education*, 16(2), 103-120.

Rickinson, M., Dillon, J., Teamey, K., Morris, M., Choi, M. Y., Sanders, D., & Benefield, P. (2004). *A review of research on outdoor learning*. Preston Montford, Shropshire: Field Studies Council.

Strauss, A., & Corbin, J. (1990). *Basics of qualitative research (Vol. 15)*. Newbury Park, CA: Sage.

## **BAYER KIMLU SCIENCE CAMP: A PLACE FOR INSPIRING THE NEXT GENERATION OF SCIENCE LEADERS**

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From 2012 to 2016, the Bayer Kimlu Science Camp has been operated in Chile, and been held at the Karukinka Park, Tierra del Fuego. This program is joint venture of the Youth Science Foundation Chile and Bayer AG.

Each year, 40 young people –between the ages of 14-18 years old- and 10 mentors –undergraduate and postgraduate science careers- participate in the program.

Bayer Kimlu is focused in a science education and leadership-training program, with the aim of inspiring and connecting the next generation of science leaders of Latin America. The program also aims to promote STEM and leadership competences, through the experience of a science camp –and an alumni network- with hang-on and inquired based strategist.

With 5 years of experience; more than 2000 applicants and more than 200 alumni from Chile, Argentina, Uruguay and México, the program has shown its impact with more than 95% of its alumni studying a science-related academic program, changed in the perception of science by the participant and the increased in science and leadership competences.

A video summary of the program can be found at: <https://www.youtube.com/watch?v=8gW9lyMSIm0>

## **CHANGE OF PRESERVICE TEACHERS' ENTREPRENEURIAL TENDENCY THROUGHOUT THE TEACHER TRAINING PROGRAM**

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The new trend in education requires students to have different skills than their parents hold. With the integration of STEM approach into school curriculum, students are equipped with additional skills which provide them the opportunity to start their own business in early years of their career. Starting early career requires having some qualifications such as taking the initiative, risk taking, critical thinking, creativity, problem solving, communication, presentation, and planning skills. These are the some of the component of entrepreneurial skills. Many schools tend to integrate these skills into their curriculum to students have these skills. A way to instruct these qualifications requires having a teacher who has entrepreneurial mindset and valuing the entrepreneurship education. The current study investigates the development of entrepreneurial approach of preservice science teacher throughout the teacher training program. Around 150 preservice elementary science teachers took a test to express their entrepreneurial tendency and results are evaluates parallel to the program of training. Suggestions are more practical courses needs to be added to the program in early years of training and students should be provided more opportunities to reveal their skills.



## **ASSESSMENT OF COLLEGE STUDENTS' ATTITUDES AND MOTIVATION TOWARDS SOLID WASTE MANAGEMENT IN PANKSHIN, NIGERIA.**

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The waste management sector is facing numerous challenges globally. Huge amounts of municipal and industrial wastes are produced daily world-wide as a consequence of human activities because of the astronomical growth in human population. These result in human health risks, ecosystem degradation, contamination of soils and water, greenhouse emissions, global warming and climate change. The risks are more obvious in developing regions of the world than in developed ones. Nigeria, as a developing nation has put in a lot of efforts aimed at managing solid waste, such as, establishment of environmental protection agencies at the three tiers of government. Moreover, environmental education has been infused into the basic and secondary school curricula as a cross-cutting subject. However, these efforts by the Nigerian government do not seem to have yielded the much desired results. Solid wastes are still found littered and in dumps in urban and rural regions of the country. Review of available literature shows that most of the studies conducted on solid waste management concentrated on households and communities with a few on secondary school students as participants. Moreover, there is paucity of studies on assessment of attitudinal dispositions and motivation of individuals, particularly, prospective teachers in tertiary institutions towards solid waste management in Nigeria. This is a critical area that should be investigated since teachers are implementers of government's strategic plans and policies. This study, therefore, investigated college of education students' attitudes and motivation towards solid waste management in Pankshin, Nigeria. The participants for the study comprised 60 final year Nigerian Certificate in Education (NCE) students. The zero sampling technique was employed in the investigation while Students' Attitudes and Motivation to Solid Waste Management Questionnaire (Comprising two subscales) was used to collect data for analysis. The construct validity of the instrument was determined as adequate while the internal consistencies of the attitudes and motivation sub-scales were calculated as 0.83 and 0.89, respectively using the Cronbach alpha method. Results of the study showed that most participants had positive attitude towards solid waste management and moderate level of motivation, respectively. The results further showed that participants who were science majors were more motivated to solid waste management than their non science-major counterparts. Furthermore, male and female students were shown not to differ significantly in their attitudes and motivation towards solid waste management, respectively. It was concluded that the participants had positive attitudes and moderate level of motivation towards solid waste management. The implication of the findings of the study is that students should be adequately motivated, sensitized and encouraged to engage in practical solid waste management activities while in school, among others.

## DESIGNING AN ICE-CREAM MACHINE: AN ATTEMPT TO COMBINE ENGINEERING WITH SCIENCE LEARNING

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Design-based science learning (DBSL) is a learning approach which combines the elements of inquiry learning with engineering design and it is found to be effective for learning both science content and science process skills (Vattam & Kolodner, 2008). Still, more research is needed about its practical application in a basic school science classroom. Therefore, the aim of the current study was to find out what are the biggest challenges for teachers and students when DBSL was applied. A DBSL module, called "Designing an ice-cream machine" was implemented which was geared to provide students with basic knowledge about thermal effects of dissolution, energy conversion and transfer and develop further their scientific reasoning, innovation and collaboration skills. It was expected that students, after studying science phenomena through inquiry approach, develop their own design solution for an ice cream „machine“, execute their design ideas, apply for a patent for their invention and present their product to their classmates. The module was taught to 9th grade students (N=24) throughout four ordinary science lessons (à 45 min.) in an Estonian school by the first author who was also their regular science teacher. The teacher has had previous experiences with teaching context-based and design-based science modules in her classroom. The process of learning was investigated by classroom video records and students' written reports. Based on the results, the biggest challenges for students were mainly related to organising meaningful collaboration and sharing responsibilities within their group work activities. Some studies (Crismond, 2001; Vattam & Kolodner, 2008; Apedoe & Schunn, 2013) have found that students tend to have difficulties with transferring their previously learned science knowledge into a following design situation. Still, it was not found to be a problem in the current study. The last claim is supported by video data where students in a number of cases reminded each other what they had learned during their previous inquiry sessions and how it could benefit their design solution. The authors attribute this finding to the viability of the developed module which seemed to support students' science knowledge transfer needed for successful design. The biggest challenge for the teacher was to find the equipment and materials suitable for students' creative design projects and to manage with a given time frame. Practical guidelines will be provided for teachers to facilitate further adoption of a given DBSL module in science classroom.

### References

- Apedoe, X., & Schunn, C. D. (2013). Strategies for success: Uncovering what makes students successful in design and learning. *Instructional Science*, 41, 773-791.
- Crismond, D. (2001). Learning and using science ideas when doing investigate-and-re-design tasks: A study of naïve, novice, and expert designers doing constrained and scaffolded design work. *Journal of Research in Science Teaching*, 38, 791-820.
- Vattam, S. S., & Kolodner, J. L. (2008). On foundations of technological support for addressing challenges facing design-based science learning. *Pragmatics and Cognition*, 16, 406-437.

## **EVALUATION OF THE USABILITY AND CHALLENGES FACING THE ADOPTION OF ONLINE BASED CLOUD SERVICES IN NATIONAL OPEN UNIVERSITY OF NIGERIA, NORTH CENTRAL ZONE**

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This paper evaluated the usability of online-based cloud services in National Open University of Nigeria (NOUN) in North Central Zone and challenges facing their adoption. To achieve the objective, this study four research questions were raised. The study adopted the cross-section survey design. A sample of centers and students was selected using proportional stratified sampling technique. The population for the study consisted of 10827 participants consisting of 10,590 students and 237 facilitators from three study centers (Abuja, Jos and Lafia) in the North Central Zone of Nigeria. From this population, a sample of 2165 participants, consisting of 2118 students and 47 facilitators was drawn. Five instruments were used for data collection, namely, Students' Questionnaire, Facilitators Questionnaire, Students' Interview Schedule, Facilitators Interview Schedule and Usability Checklist in NOUN Study Centers. Data were collected using five instruments and a questionnaire developed by the research tagged. Data obtained were analyzed using descriptive and inferential statistics. Results from the study showed that the most adopted on-line based cloud services in NOUN study centres was e-mail and majority of staff and students did not use the on-line based cloud storage services. A few of them were found using storage infrastructure. Again, few had never come across any Online Cloud Collaboration Solution, Virtual Office Online Suite Solutions and Online Extra Processing Power. The percentage of awareness of the usefulness of online based cloud services at NOUN study centres was found to be low. It was observed that lack of internet connectivity, network fluctuation, poor knowledge of online cloud services by facilitators and students, malfunctioning of cloud services hardware facilities and non-availability of cloud services packages were impediments to the use of online based cloud services in NOUN study centres. The restructuring of curriculum in a way that cloud computing and its numerous benefits and opportunities can be taught in NOUN, provision of adequate and constant availability of internet network connection by management, employing the services of professionals and constant orientation of facilitators and students on new developments in cloud computing were recommended.

## **NATURAL HISTORY DIORAMA: AN OPPORTUNITY OF HISTORICAL AND EXPERIMENTAL SCIENCE WITH CHILDREN**

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The nature of scientific research goes beyond the learning of concepts and basic manipulation to the key factors of engaging students in identifying relevant evidence and reflecting on its interpretation. It is argued that young children have the ability to acquire viable realistic concepts of the living world when involved in relevant activities (Tunnicliffe, 2000). Visiting a museum of Natural History is an educational experience, which offers, children experiences that cannot be obtained within the classroom and found that museums are excellent sources of cognitive experiences that complement and / or enrich the curriculum of formal education (Dillon et al., 2016). Dioramas have specific context which give the visitors the opportunity to be creative and have more learning opportunities when they are engaging with them (Achiam et al., 2014).

This paper draws upon a pilot study which focused on aspects of historical and experimental aspect of physical science in action, shown in, the animals featured which may be identified in natural history dioramas and the responses of some children to identifying such for themselves in a natural history museum in the south of England which focuses on African and Indian dioramas.

Observing natural history dioramas provides learners with opportunities to identify various aspects of particularly biological and physical science captured in the moment of time portrayed in a given diorama drawing on information from sources of both formal and informal education. The dioramas are used either as historical or/ and experimental resources of science.

The context based learning based on learning for an experiences such as a museum visit by interpreting new information in the enrich context of the natural history dioramas and provide the opportunity to students- visitors to be introduced to basic physical science such as balance, basic forces and centre of mass which are shown in most dioramas, especially those with terrestrial vertebrates, as well as sound and light.

This approach is based on Inquiry based learning which enables students to contrast their ideas and deepen their learning. Pilot study response to dioramas shows that the effect of a series of simple workshop activities with the learners resulted in a greater awareness of the science in action as using the dioramas as resources of experimental science. Also, groups of students- visitors use the dioramas as resources of historical science and also explore aspects of physical as well as biological.

The students using an inquiry based approach both concepts historical and scientific became familiarised with the use of dioramas. During the workshops, and the observation of diorama which explore some basic physic concepts using with simple everyday materials and making final conclusions and present results by revisited the dioramas to interpret the scenarios again, the time the students connected what they observed with the prior knowledge. On returning to the diorama the students recognised these inherent science ideas of

balance, stability and centre of gravity in their interpretation of the dioramas, which they observed. They interpreted the actions in their own terms. Designing such learning strategies the educators knowing the foundation knowledge that the children possess. The results of this study showed us that cross over learning in informal setting such as museums can link to educational contexts. Authentic experiences such as museum visit and the interaction with the dioramas promote the students' links with the formal curriculum.

The study of informal education is seen as particularly critical because children seem to build much of their knowledge about the world around them using as resources natural history dioramas. It shows science in a context. Transcripts of the dialogues in workshops and at the dioramas were collected and analysed through a read re-read iterative process through which categories of comments emerged. Simple counts were made of responses. These workshops led to children being able to identify the basic physics in action.

### References

- Achiam, M., May, M. & Marandino, M. (2014) Affordances and distributed cognition in museum exhibitions. *Museum Management and Curatorship*, 29(5), 461- 481, doi: 10.1080/09647775.2014.957479
- Dillon, J., DeWitt, L., Pegram, E., Irwin, B., Crowley, K., Haydon, R., King, H., Knutson, K., Veall, D. & Xanthoudaki, M. (2016). *A learning Research Agenda for a Natural History Institutions*. London: Natural History Museum
- Patrick, G., P & Tunnicliffe, S., D. (2013). *Zoo Talk*, Springer
- Tunnicliffe, S., D. (2000). Conversations of family and primary school groups at robotic dinosaur exhibits in a museum: What do they talk about? *International Journal of Science Education*, 22(7), 739-754.

## PROFILE OF THE PEDAGOGICAL HEADS OF SCHOOL ENVIRONMENTAL PROJECTS

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In the beginning of the school year, in Greek Secondary Education, are constructing the environmental teams of students and the pedagogical teams of teachers who will carry out, during the whole school years, one or more SPEEs in each school. The head of these teams undertakes the role of the coordinator, the leader of the Environmental Education in school society. This role is not clearly certified by the legislative framework of implementing the environmental education in schools, of course is not extra paid. Even her/his role and responsibilities aren't defined by ministerial circulars it supported well by people and authorities that take action in the field of environmental training. In Greece, during the last years, a great effort is attempted in EE to open the schools in society through partnerships with local authorities, institutions, parents unions and specialists, developing democratic dialogue and critical thinking with Municipalities and Bodies.

The coordinator, as a member of the pedagogical team that is responsible for the accomplishment of an environmental concern's project, takes part in work groups and coordinates the actions, in order the goals of the project to be achieved.

In this paper are analyzed the aspects of teachers who taught in Heraklion's county and had been involved, in the past, in environmental educational projects, on the profile of the pedagogical head of a school environmental project.

A common characteristic of all the teachers who take up as pedagogical heads of SPEEs concerns in their organizing ability as well as fact that they are keen on making research. Also, they are keen on gaining new experiences and they are willing to work hard beyond their working hours and generally to get out of the daily routine.

## **CREATIVE PROBLEM SOLVING PROCESS AS A TOOL FOR DEVELOPING BIOLOGY TEACHING SKILLS**

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The aim of this study is to find key factors of creative problem solving process needed in teaching, learning and thinking. The need for the study arises from the new Finnish national core curriculum, where creative and critical thinking are described as important future skills. Teachers and teacher students need more knowledge regarding how to use and how to support creative problem solving in all subjects during the teaching and learning processes.

The data was collected during a 6-week biology course designed for class teachers (N=27) in the teacher training department at University of Helsinki 2014. In every lesson methods of creative problem solving were used. A variety of evaluation methods, especially peer evaluating had an important role during the course. According to a preliminary analysis (deductive qualitative analysis of pre and post mind-maps) three areas was improved: understanding about the creative problem solving method pedagogy is developed, characteristics of the process was identified and students personal development was reflected. As most important characteristics of the process was mentioned: bearing the uncertainty, importance of creative atmosphere, discussions and peer evaluation. Students have had the feeling that motivation during the course was growing continuously: problem solving has not stopped by the end the course.

This study encourages the practise of different teaching tools during the pedagogical studies more. Teaching itself should be innovative and there should be a place for pupils' creativity.

## MAPPING OF ENVIRONMENTAL EDUCATION IN JAMBI PROVINCE

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The aim of the provincial district level surveys was to assess and ascertain the general capacity to support Environmental Education (EE) in formal education through their policies, programs, and activities. A multi-faceted assessment of EE capacity and implementation was conducted into 50 primary and secondary education schools in Jambi Province located in district Jambi, Kerinci, Tebo, Merangin, and Tanjung Jabung Timur which represent different levels and types of schools, including public, vocational, religious, pesantren, and international schools (RSBI schools), representation of school that already implement EE as well as schools that do EE as yet. Data were collected from both quantitative and qualitative primary and secondary data. Such data related to policy and regulations, curriculum, workshop results, research findings and recommendations, circulars, media and the results of any school-based programs related to environmental education. A total of 9 assessment instruments were developed for the different levels (provincial, district and school levels) based, as a starting point, on the previous MoNE's own guidelines for EE implementation in schools produced 2007. Steps of data collection are sequentially in-depth interview and questionnaire with selected government officers who are responsible for environmental education at: 1) national level; 2) provincial level with government officers and scholars and NGOs working on environmental education; 3) district level, concerning environment, climate change, disaster response and management; 4) School-level data collection through in-depth interview with the principal or assistant principal areas of curriculum, teachers, students, and school committee; 5) observation of school conditions. All qualitative and quantitative data were disaggregated by sector, department, age, sex, experience, educational background, location, type of school. The result of qualitative and quantitative analysis showed some findings and recommendation concerning: 1) EE Supporting Policy and Programs in Provincial & District Government; 2) EE Supporting Policy and Structure in Schools; 3) Human Resource EE Capacity; 4) EE integration in Curriculum; 5) Assessment for Environmental Learning and Whole School Implementation of EE; 6) Textbooks and Other Multi-media EE Learning Resources; 7) School Facilities, Management, and Utilization for EE Teaching and Learning; 8) Teacher and Student Leadership and Inclusion in Environment and EE related Decision-Making; 9) EE Networks and Partnerships.



## **THE VIEW OF SCIENCE TEACHERS RELATION TO SOCIAL JUSTICE AND EQUITY CONCEPTS**

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The aim of this study is to determine science teachers' views on social justice and equity within science education. Case study was designated as a method, in this study. For this purpose, a semi structured interview form was prepared, which has six questions to determine science teachers' views. First off all, interview form was sent to two science teachers, who actively work as science teachers at middle schools. Later on, two specialists looked into interview form, who are specialists in the field of qualitative research in the scope of measurement and evaluation. They did needed corrections on the form, and form was created finally. Interviews were carried out with 14 science teachers, and two science teachers were determined from every region. Questions mainly were created issues such as justice, social justice and equity in science education, Descriptives analysis and content analysis were used to take data. Almost all of science teachers think that there is not any justice and all of science teachers think that there is not any equity within science education.

## WHAT'S INSIDE? THE DEVELOPMENT OF CHILDRENS' UNDERSTANDING OF ORGANISMS

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There are many ways of gathering information about students' understandings of scientific phenomena (White & Gunstone, 1992). However, despite the richness and variety of the methods used by science educators, it remains the fact that most of these methods rely on students either talking or writing about science. Such methods include oral interviewing of students (Osborne & Gilbert 1980), gathering students' written responses (Leach et al., 1995), recording students' spontaneous conversations (Tunnicliffe & Reiss, 1999b) and getting students to construct written concept maps (Novak & Musonda, 1991). It has been resaid concerning the drawings of young children is "They draw what they know and not what they see", Cox, M (1992.p 88).

Children come to their biology education experience with existing mental models about phenomena which they encounter in their formal studies in school, or out of school at home and elsewhere in leisure activities. Such mental models may be viewed as representations of an object or an event. The process of forming and constructing models is a mental activity of an individual or group (Duit and Glynn 1996). The mental model is the person's personal knowledge of the phenomenon - in the case of the present paper, a specific animal species, and will have similarities to and differences from the scientifically accepted knowledge, which in the case of the present paper is such things as the taxonomic position of the animal, its significant morphological features and so on. I have been interested over a number of years to find what is the understanding of children from earliest years to post graduate level their understanding of internal organs and systems of a variety of organisms, plant and animal. Through eliciting their mental models expressed in drawings .

Living organisms have an important place in children's lives. Children learn about animals and plants from their earliest moments (Keil, 1979), Knowing about plants and animals and their place in the world means that children hold a mental model of the organisms and their surroundings. Furthermore, children have ideas about what living things look like inside from their earliest years. Exploration of this can come from asking them to draw what think living things look like inside. There everyday talk in home refers to anatomical parts such as brain and stomach. Thus their first biology learning comes from the home and the everyday environment. There are, we believe, interesting ideas here about how children's drawings model evolutionary histories (i.e.. ontogeny recapitulates phylogeny) which increases in understanding as they grow older. As living in the biological domain they are themselves a living system and recognise that other living organisms are too and thus have the same requirements for sustaining life, such as for example, energy supply and use, as do themselves. Gradually they appreciate that such is achieved in different ways shown in internal anatomy of both plants and animals but with a fundamental plan. The use of drawings though must be analysed with caution, especially around how well children think they can represent what they think. Plant drawings often show human characteristics, including muscles and skeletal elements. A shift away from 'human anatomy' in school would support a better understand-

ing of anatomy and physiology of the living world. There are big issues to think about around subject knowledge and pedagogy here. This talk will illustrate using drawings the increasing understanding of the internal organization of organisms with implications for teaching.

### References

- Cox, M (1992) *Children's Drawings*. London, Penguin. Page 88.
- Duit, R. and Glynn, S. (1996) *Mental Modeling*, in *Research in Science Education in Europe*, ed. G. Welford, J. Osborne and P. Scott, pp. 166-176. Falmer: London.
- Keil, F. C. (1979). *Semantic and Conceptual Development: An Ontological Perspective*. Cambridge, MA: Harvard University Press.
- Leach, J., Driver, R., Scott, P., & Wood-Robinson, C. (1995). Children's ideas about ecology 1: Theoretical background. design and methodology. *International Journal of Science Education*, 17, 721-732.
- Osborne, R. J., & Gilbert, J. K. (1980). A technique for exploring students' views of the world. *Physics Education*, 15, 376-379.
- Novak, J. D., & Musonda, D. (1991). A twelve-year longitudinal study of science concept learning. *American Educational Research Journal*, 28, 117-153.
- Tunnicliffe, S. D., & Reiss, M. J. (1999b). Building a model of the environment: How do children see animals? *Journal of Biological Education*, 33, 142-148.
- White, R. T., & Gunstone, R. F. (1992). *Probing understanding*. London: Falmer Press.

## A MICRO-ANALYTIC INVESTIGATION OF INQUIRY PROCESS IN SCIENCE CLASSROOM

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According to psychologists and educational scientists, student involvement in learning process is one of the most important aspects in learning processes (Freeman et al., 2014). In science and mathematics education, inquiry-based learning is known as a natural way to get involved in learning process (Lazonder & Harmsen, 2016). Inquiry-based learning is an educational strategy in which students work like scientists to understand knowledge about the natural world (Keselman, 2003). If this strategy is properly applied in science classroom, it provides some opportunity to student for developing some inquiry skills. Planning investigations, developing hypotheses, forming coherent arguments, and working collaboratively, among others, are considered as such skills. Although several researchers value the inquiry-based science learning and the inquiry processes (e.g. Day, Ignash, & Smith, 2013; Wilder & Shuttleworth, 2005), many science teachers have difficulties in how to provide their students opportunities for inquiry. Drawing upon such demands, this study investigates the interactional management of inquiry process via conversational analytic perfective in classroom talk. The reason for using this method is that conversation analysis practices closer to the phenomena than most other approaches such as discourse analysis (Ten Have, 2007). The study draws upon transcriptions of video and audio recording which are approximately 4,5 classroom hours (181 minutes). The data were collected two-week period in a public school in science classroom. Jeffersonian transcription system was used for the transcripts. The results suggest that teacher's reflective answers and questions start inquiry process, and students in-group express potential reasons related to the phenomena. Each of these patterns will be discussed on classroom episodes from classroom talk. The implication of such results to classroom practice will also be discussed in this paper.

### References

- Day, M. M., Ignash, M., & Smith, L. A. (2013). 5E Learning Cycle and the Gas Laws: Constructing and Experimenting with a Ping Pong Popper. *Journal of Laboratory Chemical Education*, 1(4), 65-69.
- Freeman, S., Eddy, S. L., McDonough, M., Smith, M. K., Okoroafor, N., Jordt, H., & Wenderoth, M. P. (2014). Active learning increases student performance in science, engineering, and mathematics. *Proceedings for the National Academy of Sciences of the United States of America*, 111, 8410-8415. doi:10.1073/pnas.1319030111
- Keselman, A. (2003). Supporting inquiry learning by promoting normative understanding of multivariable causality. *Journal of Research in Science Teaching*, 40(9), 898-921.
- Lazonder, A. W., & Harmsen, R. (2016). Meta-Analysis of Inquiry-Based Learning Effects of Guidance. *Review of Educational Research*, 0034654315627366.
- Ten Have, P. (2007). *Doing Conversation Analysis* (2nd Edition). London: Sage.
- Wilder, M., & Shuttleworth, P. (2005). Cell inquiry: A 5E learning cycle lesson. *Science Activities: Classroom Projects and Curriculum Ideas*, 41(4), 37-43.

## **IMPROVING SCIENTIFIC LITERACY THROUGH SCIENCE TEACHING**

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Science and Technology are very important to our lives and the overall development of any nation. They are the ground norms of Nations Technological Transformation. Therefore, the teaching of early basic concepts of Science and Technology to learners is crucial in shaping them become lifelong learners and self reliant citizens and agent for scientific and technological transformation in any nation, Nigeria inclusive. How to achieve these objectives by Science and Technology teachers has been the bane. This paper being a survey work provides teachers and stakeholders in the Education industry the Practical methods and strategies for science teaching, and how to correctly employ them to achieve the objectives. It also x-rays the various characteristics of the hand on, mind on strategies and their application and adaptability in Science Teaching. Some recommendations were also presented.

## **EXPERIMENTAL SKILLS IN HIGH SCHOOL CHEMISTRY CLASS IN TURKEY AND FRANCE**

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Experimental activities have vital roles in chemistry education. This study investigates chemistry experimental skills of institutional expectations in high school level both in Turkey and France. A content analysis was carried out to address this issue. First, the curricula and chemistry textbooks were analysed and targetted experimental skills were identified. Based on that targetted skills from Turkish and French cases were compared. The results indicate that the expectations and skills are different in both countries as a result of priorities and educational policies.

## THE ASSESSMENT OF PRESERVICE SCIENCE TEACHERS' UNDERSTANDING OF THE CONCEPT OF ATMOSPHERIC PRESSURE

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Atmospheric pressure is the pressure exerted by the weight of air in the atmosphere of Earth. Because air is invisible and hard to detect by the sense of touch, students usually have difficulty understanding gases and their role in atmospheric pressure. This study aims to reveal preservice science teachers' understanding of the concept of atmospheric pressure. The participants were freshman preservice science teachers enrolled in a semester long General Chemistry I course at a public university in Turkey. Thirty-three preservice teachers participated in this study from one class. Twenty-seven percent of them were male and 73% were female. The author of this paper taught the General Chemistry I course. The research was conducted at the first semester in the academic year of 2013/2014.

In this study, preservice science teachers worked in small groups so they had the opportunity to think and discuss about the questions of the study. Besides, they had to work together to produce one written answer in the written frame. They completed the activity in one 50-minute lesson. The 8 groups in the study were either all female or all male. Three open-ended questions related to daily phenomena about the concept of the atmospheric pressure were used as data sources. The questions were as follows; Why does atmospheric pressure decrease as altitude increases; Does water boil faster at sea level or on the top of a mountain; Does cooking is faster in higher or lower altitudes. Students' responses were analyzed in detail and classified in five different categories: (1) sound understanding, (2) partial understanding, (3) specific misconception, (4) no understanding, and (5) no response. These categories have been used before in the literature (Birinci-Konur & Ayas, 2010; Lin, Cheng & Lawrenz, 2000; Özmen, Ayas, & Coştu, 2002; Öztürk-Ürek & Tarhan, 2005; Yıldırım, & Birinci-Konur, 2014). In this study, sound understanding (SU) was used when responses include all components of the acceptable responses. Partial understanding (PU) was used when responses include at least one of the components of the acceptable response. Specific misconception (SM) was used when responses include misconceptions. No understanding (NU) was used when students repeated the question or their answers could not be categorized. Lastly, no response (NR) was used when students did not answer the questions.

Analysis of the data showed that half of the students responded to first question in PU and the other half responded in SM categories. An example of PU category for the first question is: "Because of gravity, pressure is greatest at sea level and diminishes with increasing height in the atmosphere". Also, the following is an example of SM categories for this question: "It is related to both temperature and volume because of ideal gas law." Second and third questions of the study were about the effect of atmospheric pressure on the boiling point of water. The percentages of the group responses to second question in SU, PU, SM, and NU categories are 12.5%, 25%, 50%, and 12.5%, respectively. As it is seen, the majority of groups were not able to provide sound explanations for this question. Unfortunately, for the third question, the percentages for SU and PU are getting lower. The percentages of the students' responses to

third question in PU, SM, and NU categories are 37.5%, 12.5%, and 50%, respectively.

The results led us to conclude that even after having been taught the concept of atmospheric pressure, the majority of preservice science teachers were not able to provide sound explanations on the three conceptual questions. This is important because the questions used in this study required conceptual understanding of the concept of the atmospheric pressure and the ability to apply this knowledge in everyday life. In other words, the results showed us that preservice teachers did not have sound understanding about the concept of atmospheric pressure.



## DOES DEVELOPED MEAN MORE ADVANCED: STEM TEACHER TRAINING IN URUGUAY, A CASE STUDY

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### Introduction

This case study presents findings from a project initiated by the British Council to provide support and advice for STEM education in Uruguay. The project involved a series of workshops for those developing a new blended learning curriculum for teacher education and training in in Uruguay. This was a unique opportunity for collaboration between teacher educators with expertise in curriculum design from Ireland and England, and STEM teacher educators from Uruguay. It provided an opportunity to reflect on the processes of developing a curriculum for STEM teacher education in differing contexts, not just the content and curriculum design but also the challenges and opportunities of delivering teacher training at a distance through blended learning.

### Research Questions:

1. What are the key questions that require answers in the development of a STEM teacher training curriculum?
2. What are the challenges and opportunities provided by delivering teacher training in a blended learning context?

### Background

Unusually access to technology is not an issue; fibre optic broadband is available throughout the country and plan Ceibal ensures every pupil has their own computer. Universidad de la República has overall responsibility for teacher training in collaboration with Agencia Nacional de Evaluación y Prospectiva (ANEP). ANEP also has responsibility for school education. Most teacher training makes use of distance learning.

The 14 STEM teacher trainers had responsibility for training for Biology, Chemistry, Physics, Mathematics, Technology and overall STEM teacher training. This paper preserves anonymity of individuals.

### Methodology and Data

A qualitative case study methodology was used. The workshops involved a set of collaborative activities designed to explore purposes, elements and construction of a curriculum into a coherent whole.

Data sources included workshops plans and PowerPoint presentations, recordings of the reflections made by the two visitors after the end of each day, field notes of oral inputs made by the Uruguayan collaborators, transcriptions of discussions, summary notes from discussions made in front of the group members on boards recorded as digital images, summary document of outcomes which was shared with all.

The work presented here is from the first phase. The authors are the two visitors from Ireland and England.

## Conclusions

The key themes that arose were not those that the researchers had predicted before the start of the project. There were similar concerns about designing a new curriculum for example: how to define what it is most important for teachers to know; how to introduce new pedagogies and teaching approaches; practical work. However, in addition the authors identified some quite different challenges unique to the Uruguayan context for example: the delivery of all teacher education at a distance; how to develop teacher identity; how to use technology to support students' learning?

This is a summary of the main issues raised by participants during the workshops together with some ideas we discussed about the next steps towards resolving these issues.

Key questions raised and potential solutions:

How to ensure that the changes we want to make in teaching practice and the changes to teacher training are adopted by schools.

1. Determine the steps towards the changes you want to make and prioritise. Aim for small steps towards change.
2. Develop school partnerships – work with school to make change happen.

How to ensure teachers do not revert back to old practices.

1. Empower teachers; develop teachers thinking skills - particularly critical thinking, meta-cognition and reflection skills.
2. Develop teachers' professional identities

How can you ensure teachers have a focus on school students learning?

1. Develop teachers' knowledge about how pupils learn and how they construct meanings from what we teach.
2. Encourage teachers to use formative assessment techniques and questioning skills to diagnose the levels of pupils understanding.
3. Introduce enquiry approaches in the STEM curriculum to develop a focus on teaching for understanding, rather than rote, drill and practice.

How can we determine the most important things for teachers to know? 1. Determine what type of teachers you want to develop and the aims education needs to fulfil

2. Look at the key knowledge and skills requirements for the core knowledge domains: Subject Knowledge, Professional studies, Subject Pedagogy, Research, Continuing professional development

How can we use knowledge of research to develop a greater impact on pupils learning?

What should be the balance between knowledge of:

research methods and approaches,

research in the subject area,

research on how to teach the subject area?

## THE VIEWS OF SCIENCE TEACHERS ABOUT GENDER EQUITY IN SCIENCE EDUCATION

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The aim of this study is to investigate science teachers' views about gender equity in the scope of science education. Quantitative method is fixed within this research and survey method was used. A survey was developed to fix teachers' views within the gender equity. It has 35 matters in the scope of gender issues. Two experts, who are experts in the field of measurement and evaluation, looked into survey matters' for validity. And also two science education specialists looked into it. After experts views about survey, some changes were done. Finally, survey prepared as a 5 likert scale. Survey matters mainly focused on these dimensions: "Science textbooks, science teaching programme, science achievement, gender policy in science education, the effect of racism and ethnicity on gender". 160 science teachers answered the survey. The answers of science teachers were analysed with Social Package for Social Sciences (SPSS 22.0). The criterias for analyzing were such as ages, gender, education status, school type, tenure etc. Independent sample t-test, Anova test and frequency techniques were used within the SPSS. It was determined that many of science teachers don't think that there isn't any gender equity in the scope of science teaching programme and science textbooks, in Turkey. Science teachers' views point of there aren't any gender policies in science education, in Turkey. They believe gender equity is very important on science achievement. They think racial and ethnic factors are both effective on gender equity, as well. At the end of this study some recommendations are given about gender equity in science education.

## **EXPLORING PRE-SERVICE PRIMARY TEACHERS' DRAWING OF THE DIGESTIVE SYSTEM**

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This study explores pre-service primary teachers' drawing of the digestive system. The research data was collected through the use of drawing method with the third grade pre-service primary teachers studying in the Faculty of Education at Trakya University during 2016-2017 academic year. The findings revealed that primary teacher candidates' drawings of the digestive system were quite far from the scientifically acceptable ones. They commonly had lack of knowledge about the digestive system organs, especially composition and size of them in the human body. These results shows that, in teaching and learning process, drawings are an important tool in revealing knowledge shortages or misconceptions, and may be used more commonly in improving students understanding of some scientific phenomena.

## PRACTICAL CHEMISTRY IN ROOMS?

*Robert Worley*

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The situation is not ideal and many teachers will think that any chemistry practical work is out of the question. Here are some new and improved microscale techniques which enables the teacher to achieve practical work in chemistry.

UNESCO(1) promoted microscale techniques in over 70 countries, to involve children in practical work where there are few laboratory facilities. Success has been variable and it demanded a real enthusiast, supported by committed senior school managers and education ministers to see it through. It used a most ingenious kit but it can become difficult and expensive to replenish and maintain kits after continual use.

The UK is lucky in that many schools have laboratories but recent new building initiatives have reduced the number of labs so that increasing numbers of teachers find themselves working in ordinary classrooms. They have remarked that the techniques pioneered at CLEAPSS(2), have been very useful.

This presentation (with videos(3)) will include an exhibition of equipment and instruction sheets which basically consists of plastic pipettes, Petri dishes and plastic folders. It will show that with modern inexpensive IT facilities there are still plenty of wonderful images(4) and experiments to inspire students. No bought kit is required.

However, there is pedagogic “added value”(5) to these techniques that they are now being used in UK school laboratories. Chemistry is noted as being difficult(6). By removing much the traditional chemical equipment and using modern materials, the cognitive load on the short-term working memory can be reduced, thus allowing the teacher to focus on the chemistry. These procedures are also quick so that the teacher can cover the theory and explanations at the same time as the demonstration/experiment. Using the correct equipment such as burettes etc can come much later and are more easily assimilated by the students once they realise what they are doing.

Areas covered will include

- Easier for students to manage
- Reduced practical time, allowing for more discussion and questioning
- May be used to challenge the misconceptions that make chemistry into a very difficult subject.
- Lowers demands on short term working memory
- Follow Instructions or Open Inquiry
- Safer procedures
- Reduced costs
- Reduced waste, less time in clearing up and disposing of waste

- Uses modern materials and equipment
  - It addresses a green agenda.
1. [http://portal.unesco.org/science/en/ev.php-URL\\_ID=6811&URL\\_DO=DO\\_TOP-IC&URL\\_SECTION=201.html](http://portal.unesco.org/science/en/ev.php-URL_ID=6811&URL_DO=DO_TOP-IC&URL_SECTION=201.html)
  2. [www.cleapss.org.uk](http://www.cleapss.org.uk)
  3. Many are on <https://www.youtube.com/user/CLEAPSS>
  4. [www.microchemuk.weebly.com](http://www.microchemuk.weebly.com)
  5. <http://www.rsc.org/education/eic/issues/2012May/microscale-chemistry-revisited.asp>
  6. Learning Difficulties in Chemistry: An Overview, Journal of Turkish Science Education Volume 4, Issue 2, September 2007

## **EDUCATIONAL OPTIONS FOR OIL POLLUTION REDUCTION IN THE NIGER DELTA REGION OF NIGERIA**

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Industrialization involves several processes which has adverse effect on the environment. Apart from the economic value and other benefits of industrialization, the bye-product of pollution include death of aquatic and terrestrial lives, degraded land and poverty as a result of interruption in the economic activities of the affected communities. The environmental impacts of pollution are reflected in the biological, physical, socio-cultural, economic and political aspects of life. The impact of pollution on the socio-economic life of people to some extent has negative effects on the health, income and everyday life. The unsuitability of the degraded land and the polluted water, creeks for agriculture and their favourite traditional occupation of fishing has led to hardship and poverty in the region. Various studies on pollution of Niger Delta region have revealed shockingly that 5m depth of land were polluted and entrepreneur fishing business in creeks almost completely ruined. Recommendations were made to the Government of the need to partner with oil companies to clean up the Niger Delta. There are health and economic implications which could be addressed by some educational options from curriculum design, implementation and public enlightenment of all age groups. This is to raise awareness of the people particularly in the immediate communities and the public in general. Thus, providing preventive measures from diseases associated with pollution incidences and safeguards the land and water resources in the Delta region from further pollution. With adequate measures put in place, the affected communities would be economically empowered through improved incomes as a way of poverty reduction from the consequences of degraded environment.

## **PRACTICAL WORK PROVOKED AND PROMOTED BY THE HISTORY OF ACIENCE: A WAY INTO THE NATURE OF CHEMISTRY**

***John Oversby***

*Science Education Futures, UK*

Traditional chemistry classes deal only with concept development. This study uses the context of acidity to develop philosophical ideas about theory, concept, model, law and idealization for 150 12 year old students. It is based on work for the EU History and Philosophy in Science Teaching (HIPSTE) project. Data included field notes of individual and whole class discussions, pupil recorded notes, behaviour in practical work, and an innovative final assessment based on construction of a box with sides to display what had been learned.



## SCIENTIFIC SKILLS AND CONCEPT LEARNING BY RURAL WOMEN FOR PERSONAL AND NATIONAL DEVELOPMENT

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Science plays a vital role in the lives of individuals and the development of a nation. It is widely acknowledged that the gateway to the survival of a nation scientifically and technologically is scientific literacy which can only be achieved through science education. It becomes worrisome when those essential life skills and knowledge needed for development are lacking among rural women who are potential agents for national development. Ghandi (2011) states that of the world' nearly one billion illiterate adults, 213 are women; also 2/3 of the 130 million children worldwide who are out of school are girls. In Nigeria, women participation in the industrial sector is 11% and men 30% even though 87% of women are employed in the service sector in the federal service, 76% are men while 24% are women; but in the management level position 17.5% are women and men 82.5%. In addition, among 70% of the population estimated to be living below poverty line, 60% are women and their purchasing power is US \$614 as against men of US \$1,495 (FRN 2006). Child mortality and morbidity rates remain alarmingly high. Prevalence level of communicable diseases are high among rural women populace and is attributed to bad sanitation and lack of education and access to portable water. Thus, infection rate among female 20-24 years is 56% while 60% is between 15-25 years. In agriculture women are responsible for carrying out 70% of the labour, 50% of animal husbandry and 60% of food processing activities which they know little or no scientific basis of it. A survey carried out by Friedrich (1998) and Agbo (2010) revealed that rural women have little or no scientific knowledge and skills on their daily life activities as a mother, labour provider, family nutrition, management and care of water, and storage of farm produce. It is against this background that this researcher developed and validated a non-formal science programme package to empower and enhance the rural women with knowledge and skills on their daily activities e.g. Nutrition, sanitation, health, agriculture and water use so as to improve their high productivity and consequently facilitate national development. This research is a quasi-experimental one group pretest and posttest design. The programme was taught for 6 weeks to see its effect on the rural women. The result shows that there were appreciable improvement on their skills and knowledge in all the variables considered. Based on these findings, it was recommended that rural women should be empowered with science education for maximum productivity for national development.

## **A PROFILES BASED TEACHING AND LEARNING MODULE: HOW CAN WE CREATE AN ICE-CREAM CAR WHICH GOES ON THE BEACH USING WIND?**

*Bulent Cavas, Selin Nur Sayar, Sercan Senel*

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The main aim of this paper is to introduce a PROFILES based teaching and learning module. This module leads to a decision making activity, designed to consolidate learning about Design and technology; Using mechanisms – gearing down, Assembling components, Combining materials, Renewable energy, Measuring area, Measuring distance, Measuring time, Forces, Friction, Air resistance, Pressure, Scientific investigation, taking examples from everyday life and to introduce the friction, energy and power.

## **INFORMATION AND COMMUNICATIONS TECHNOLOGIES IN SCIENCE EDUCATION TEACHING: RELEVANCE AND APPLICATIONS**

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Information and Communication Technology (ICT) has become so relevant and nearly a sine qua non in all aspects of our lives in the contemporary society. In Education in general and Science and Technology Education in particular, the relevance and the application of ICT to Science Education teaching is germane. How to properly apply ICT to Science Education teaching resides with the science teacher who transfers the values through the act and science of teaching. So in this technological age the professional development of the teacher should include the applications of various kinds of technologies to foster their effectiveness and making students grasp the subjects matter with ease. This paper examines the relevance and application of ICT to the teaching of Science Education in schools in Nigeria with a view to equipping the science teacher modern methodologies in the application of ICT in teaching of Science Education. The paper also presents some successful recommendations.

## **GYMNASIUM STUDENTS' CONCEPTIONS OF TECHNOLOGY AND ORIENTATIONS TOWARDS TECHNOLOGY RELATED CAREERS**

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**Problem:** As an understanding of the nature of technology (NOT) has clear implications for a productive citizenship as well as for recognising, addressing and foreseeing the down-sides of technology, science and technology education standards in many countries have highlighted the importance of the development of students' understanding of the nature of technology (Ministry of Education, 2007; ITEA, 2000, 2002, 2007, etc.). Notwithstanding these initiatives, there is evidence to suggest that adults, as well as adolescents, in the US and in Europe have still quite poor understanding of the NOT (NRC, 2006; Eurobarometer 224, 2005). There is also a lack of research on student conceptions about the NOT, how it relates to the nature of science and how students' understanding related to these aspects can be enhanced (NRC, 2006; DiGironimo, 2011). As indicated by different international reports (e.g. Business Europe, 2011), there is a serious decrease in young people's interest in technology related studies and careers. At the same time, there is a lack of up-to-date knowledge about Estonian gymnasium students' career orientations.

The aim of this research study was:

- to investigate gymnasium students' (a) conceptions of the NOT, and (b) orientations towards technology related careers;
- to explore the factors that are able to explain male and female students' technology related career orientations.

**The Study:** Five different frameworks were used for the development of the questionnaire: (1) Pupils' Attitudes Towards Technology instrument (de Vries, 1988; Bame et al., 1993); (2) the Views on Science Technology and Society (Aikenhead et al., 1987); (3) Project 2061 (AAAS, 1990); (4) the study conducted by DiGironimo (2011); and (5) STEM Career Interest Survey (Kier et al., 2013). The first section of the developed questionnaire consisted of 6 sub-categories: technology as artefacts, technology as a creation process, technology as a human practice, history of technology, the current role of technology in society, and the relationship between science and technology. The second section was seeking for factors such as students' self-efficacy, interests, outcome expectations, and social supports related to technology, able to explain students' technology related career orientations. The questionnaire was administered to 297 10-11th grade students from 9 Estonian gymnasiums. In order to answer the research questions, descriptive statistics and general linear models were used.

**Preliminary results:** Estonian gymnasium students in this study associated the concept „technology“ mostly with objects, such as computers and electronics while newer technological artefacts were mentioned more frequently than older. Very seldom, they referred “technology” to processes that take place within the field of technology such as inventing, designing

or testing. Students perceive technology rather as a new field in human history and tend to neglect some older artefacts and processes as part of technology. In students' opinion, technology plays mainly a positive role in society. Regarding the relationship between science and technology, the students tend to believe that science can exist without technology, but not the way around. Based on the results of the second part of the questionnaire, it was found that male students' future career goals were significantly more connected with technology than those for females. In addition, male students had a stronger background related to technology. The strongest predictors of both male and female students' future career goals in the field of technology was found to be their perceived interest towards technology, self-efficacy in technology related activities and parental expectation to enter a technology related career while teachers and school-based activities seemed to play insignificant role.

### References

- Aikenhead, G.S., Fleming, R.W., & Ryan, A.G. (1987). High school graduates' beliefs about science-technology-society. Part I. Methods and issues in monitoring students views. *Science Education*, 71(2), 145-161.
- Business Europe. (2011). Plugging the skills gap: The clock is ticking. Retrieved June, 2014 from <http://www.bussinesseurope.eu/Content/Default.asp?pageid=568&docid=28659>
- De Vries, M. (1988). Pupils Attitude Toward Technology. Report exploratory research in Virginia.
- DiGironimo, N. (2011). What is Technology? Investigating Student Conceptions about the Nature of Technology. *International Journal of Science Education*, 33(10), 1337-1352.
- Eurobarometer. (2005). Europeans, Science and Technology. Special Eurobarometer 224. European Commission, Public Opinion Analysis Sector.
- ITEA (The International Technology Education Association). (2000/2002/2007). Standards for technological literacy – content for the study of technology. Reston, VA: Author.
- Kier, M. W., Blanchard, M. R., Osborne, J. W., & Albert, J. L. (2013). The development of the STEM career interest survey (STEM-CIS). *Research in Science Education*, 44 (3), 461–481.
- Ministry of Education. (2007). The New Zealand curriculum. Wellington, New Zealand: Learning Media.
- NRC (National Research Council). (2006). Tech tally: Approaches to assessing technological literacy. Washington, DC: National Academy Press.

## THE MAKER MOVEMENT IN PRE-SCHOOL EDUCATION: A CASE STUDY USING MAKEY MAKEY

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In this digital age, the need of individuals who can create and implement a new ideas are increased. Unfortunately, the idea of creating something is not seen as one of the aims in many countries' curriculums. The maker movements aims to introduce and use new technologies for the children/learners. It also aims to support them to create new ideas and to implement their ideas using technologies. The Maker Movement build bridges the gap between digital and physical worlds. Nowadays, the importance of the maker movement have increased with the needs of education for individuals who create and implement new ideas. Although maker movements appeared in 2000s, it became a popular in the beginning of 2010 with the effect of technological and pedagogical changes. The maker movement which has reconnected the idea of linking creativity with handiwork, effects science and technology education and learning technology in the classroom settings. So, it has been integrated into curriculums in many developed countries by using STEM approach with some course like coding, robotics, etc.

In the making movement, new materials are being invented by learners such as 3D printing, robotics, microprocessors, wearable computing, e-textiles, smart materials, and programming languages. In this trainings, new technology educational kits like MaKey MaKey, Arduino, Raspery Pi, 3D printer, Mbot, etc. are used during the maker trainings.

In this study, it is aimed to investigate the performance of pre-schoolers in maker training by using Makey Makey kit. During this experimental design study, six-year old six pre-school kids were giving 5 weeks training. The first 3 weeks of the training, the information about the usage of kits and the sample applications were presented. The following 2 weeks, they were encouraged to design their own ideas by using the kits. During the training, all group activities were recorded and their productions were photographed. Collected and transcribed data were analyzed by following content analysis strategies. The codes were categorized under the themes. According to data, results showed that the students started to be more active, communicative and collaborative.

## ENRICHING SCIENCE AND TECHNOLOGY COURSES WITH ARDUINO

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**Workshop Purpose:** The aim of this workshop is to develop course materials to measure environmental variables (temperature, light, smoke, gas, humidity etc) and use the obtained data in science and technology courses.

**Workshop Description:** Educational studies like PISA, TIMSS presents some deficits in learning outcomes. Thereupon interdisciplinary approaches and integrating various subjects in learning processes become more important. For this reason, in this workshop, microcontrollers, sensors and coding will be integrated for the development of materials.

Open source microcontroller Arduino, open source coding tool Scratch for Arduino (S4A) and various sensors will be used to develop new materials.

In first section of the workshop, coding basics and electronic basics will be instructed. Then we will continue with material development process. In this process teachers will work on the learning outcomes and Arduino integraton.

We will need internet connection, 1 arduino and sensors set, 1 computer for each group and 1 projector.

**Arduino set:** 1 arduino Uno, connecting cable, 1 breadboard, jumper cables, LEDs, sensors

**Sensors:** temperature sensor, light sensor, smoke/gas sensor, soil humidity sensor, water level sensor, vibration sensor, touching sensor, motion sensor, rain sensor, ultrasonic distance sensor.

**Software:** S4A, Arduino main software and S4A firmware

## **ACTION RESEARCH: ORGANISING A VIRTUAL CONFERENCE ON SCIENCE EDUCATION JUSTICE AND INCLUSION**

*John Oversby*

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Action Research is usually concerned with formal teaching and teachers, in schools and universities. In this case, the practitioner is a science education researcher engaged in Science Education for Social Justice. It is an account of organising and implementing a virtual conference on Inclusion within this theme. It is also about broadening our understanding of Action Research to include the work of science education researchers. Naturally, very little has already been written about the role of science education conference organisers, or about conferences on science education for social justice. Nevertheless, in the spirit of opening up a distinctly new avenue for research, and one that is directly relevant to teachers of the sciences and teacher educators in the sciences, this paper is offered for consideration.

1. The research question was: what are the characteristics and challenges of organising a conference on Science for Global Justice: Inclusion?
2. The experiment was designed to include both the theme for papers and the process of running the conference.
3. Data in the form of the first paper for the conference (available at [iosteflipped.wikispaces.com](http://iosteflipped.wikispaces.com)) contained the literature research on the benefits and challenges of organising a virtual conference on Inclusion and to be Inclusive, in Science Education Research. The first paper also contained a convenor's commentary on the process.
4. A total of 12 full papers in pdf, placed in advance on a purpose-designed website, collected by personal persuasion and personal writing, formed the conference base.
5. The website also enabled discussion pages, blogs, and commentaries in a variety of forms, text, diagrams, short videos, audio files, to be uploaded. In the event, only text files were used.
6. The website also collected data relating to page viewings, and on countries of origins.
7. The final data consisted of theoretical reflection on each paper by the convenor.
8. Successes included: a) a conference of significant size in terms of paper numbers; b) viewings of papers up to around 100, a good audience for a science education research conference; c) insightful contributions from a variety of viewers.
9. Not so successful were: a) the range of papers on Inclusion; b) the total audience which remained modest.
10. In the light of comments and reflections, a second virtual conference to include face to face elements, and better publicity, is being planned.

The first paper, on the website provided above, provides a more elaborated account of the process than can be given here.



## Conclusions

So, what were the science education issues that came to the fore in this activity?

1. The conference aimed to give opportunities for more extended discussion and reflection than is possible with traditional conferences. Traditionally, in conferences, immediate questions are solicited, within a time frame measured in a few minutes. Additionally, the traditional format means that the material has just been presented and heard for the first time, requiring great powers of concentration and the capacity to process deep arguments very quickly. In this conference, the flipped nature, with the papers in advance and plenty of time to read and re-read, supported construction of highly reflective commentaries. Also, the traditional format constrains delegates to ask simple questions, often mechanical in my experience (were the classes all in the afternoons?), but the conference incorporated extended commentaries, indicating that extended thinking had taken place. The asynchronous nature of the discussions also meant that colleagues in different time zones, or only available at certain times when their professional programmes permitted, could be included in the discussions without prejudice to their circumstances.
2. The format of the conference meant that the data on contributions, including statistics of viewing, was automatically collected. It was also made available to all in the spirit of Inclusion.
3. My philosophy is to place more power in the hands of the conference participants. Often, strands are already chosen by the organisers, but in the next one I intend the strands to emerge naturally from the topics of the papers themselves.
4. This time, I was not able to widen the locality of delegates significantly, although one was from India. I will incorporate changes into the advertising schedule to deal with this.
5. Overall, I count this as Action Research, since it is part of a cycle of activity, to be undertaken over a few years.
6. My knowledge claim is that alternative provision of virtual conferences in science education research has the potential to widen participation.

## INFORMAL CONTEXTS TO IMPROVE NATURE OF SCIENCE VIEWS

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Countries have undertaken several attempts to follow the extraordinary growth in knowledge. Science education has been receiving huge attention to catch up with the revolution in the field of science and technology. Therefore, improving teaching of science, to gain scientifically literate citizens has been prioritized globally. Nature of science (NOS) was claimed to be an indispensable part of scientific literacy. Therefore several attempts have been taken by researchers to provide learners with adequate understanding of NOS. Despite of the several attempts, the outcomes of the research revealed limited results. Some researchers suggested that different venues and contexts for NOS instruction might serve better for learners to refine and revise their NOS views (Rudge, Cassidy, Fulford & Howe, 2013; Clough, 2006). However, most of the NOS studies were undertaken in the context of formal learning settings. Science centers among the informal learning centers including great potential for learners to refine and revise their NOS ideas while the learners were facing fun part of science. Despite of the science centers' potential to provide contextualized venue for NOS, very few studies have been conducted so far. Therefore, the current research explored the potential of science centers for improving pre-service primary teachers' NOS views. The study was a case study of four volunteer pre-service primary teachers who attended science center visits. The data was collected in the context of science center visits occurred as an extra activity part of science method course. Within the course, pre-service teachers were introduced the NOS concepts through explicit reflective NOS activities. Then, students visited three different science centers in Ankara, Turkey. In their first visit to science center, they were engaged in explicit reflective NOS instruction through the simple science demonstrations in the science center. For instance, first demonstration was related to static electrics, and then they were engaged in discussion on how scientists make observation and inference, and how scientists construct scientific explanation during the demonstrations. Their second science center visit was related to an insect workshop. The workshop began with a small instruction to the entomology, and then we talked about how an entomologist studies insects. During the workshop one of the researchers jumped into and made connections between the content and how scientists work. Last visit was made to a space Exploratorium in which students got information related to astronomy. Each visit were followed by a whole class discussion which students reflected on what they learned related to nature of science. Additionally, students were responsible to write a reflection paper after each visit expressing what was the challenging ideas occurred after the visit, what aspects of the visit provoked to refine and revise their ideas related to nature of science and so on. Data were collected by means of means of pre- post administration of open ended questionnaire -views of nature of science questionnaire (VNOS), follow- up interviews, observation notes and audio records of science center visits. For the data analysis, the general approach for all qualitative research data was taken. This approach includes writing reflective notes in passages, drafting a summary sheet, writing codes, creating patterns and themes, counting for frequency of codes, relating categories and making contrast and comparisons (Miles & Huberman, 1994). The VNOS-C

responses were analyzed to generate profiles of participants' NOS views. The protocol outline proposed by Lederman et al. (2002) was followed for interpretation and analysis of the VNOS-C data. Analyses of VNOS-C questionnaire results were entailed transcription and coding of the interview responses. Three types of categorization were used as "informed" (I) "adequate" (A) and "inadequate" (IA). The views were categorized as either "informed" (indicating a fully developed understanding of the NOS aspect including extended examples and deeper explanations), "adequate" (indicating a developing/acceptable view but with lack of deep explanations or examples), or "inadequate" (indicating a misconception was held by the student). Analysis of the data prior to science center visits revealed that participants generally held either naïve or adequate ideas related to NOS issues. For instance all of them believed in the so called hierarchical relationship between theories and laws. Two of them conveyed that science is an objective endeavor where as two of them conveyed subjective nature of scientific knowledge without a detailed explanation. However, analysis of post answers to the VNOS questionnaire revealed that participants improved their views either informed or adequate view regarding NOS. however, three of participants kept naïve ideas related to empirical NOS and relationship between laws and theories. Additionally, only one participant failed to recognize of tentative NOS.

## **EFFECT OF TEACHING BIOLOGICAL GARDENING ON SCIENCE STUDENTS' ATTITUDES TOWARDS ENTREPRENEURIAL SKILLS ACQUISITION FOR JOB COMPETENCY IN JOS, NIGERIA**

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The study investigated the effect of biological gardening on science students' attitudes towards entrepreneurial skills acquisition for job competency in Jos South, Plateau State of Nigeria. The participants for the study consisted of 100 Senior Secondary two (SS2) students from two intact classes in a public school. The research design employed was the pretest-posttest non-equivalent control group design. A Students' Entrepreneurial Attitude to Biological Gardening Questionnaire (SEABGSAQ) and a Biological Gardening Skill Acquisition Test were used to collect data for analysis from the participants. The instruments were validated according to psychometric standards while their internal consistencies were determined as 0.86 and 0.62, respectively using the Cronbach alpha method. The demographic data of the participants were analysed with simple percentages while the hypotheses were tested with t-test. Findings of the study showed a significant difference between the attitudes of students exposed to biological gardening exercises towards entrepreneurial skills acquisition and those of participants not exposed. The findings further showed that males and females did not differ significantly in their attitudes towards entrepreneurial skills acquisition for job competency. The authors recommended among others that, teaching of biological gardening should be made compulsory in secondary schools in Nigeria, since it has been shown to enhance students' attitudes towards entrepreneurial skills acquisition for job competency.

## VOCATIONAL ACQUISITION OF STEM TEACHERS IN CERN WORKSHOPS

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**ABSTRACT:** Louis De Broglie suggested the building of atomic physics laboratory in European Culture Conference that was held on 9th December 1949 in order to provide the previous achievement and dynamism to Europe in the fundamental sciences after the World War II. Isidor Rabi also suggested the building of a regional laboratory in 5th UNESCO Conference which was held in Florence, 1950 in order to develop the international scientific cooperation. Eleven countries decided to establish a European Council for Nuclear Research in Paris, 1951. Establishing treaty was signed by 12 countries in 1953. Approvals from the parliaments of Denmark, France, West Germany, Greece, Italy, Netherlands, Norway, Sweden, Switzerland, UK and Yugoslavia were completed on 29th September 1954, and CERN European Organization for Nuclear Research” was established . Today, CERN, having 21 members and 4.000 researchers, is the largest accelerator and research laboratory of the world, and is the center of excellence that provides opportunity to develop numerous technological products as well as many scientific discoveries. Innovations, which facilitate our lives from health to communication, energy to material science, security to food sector in every field, emerge through technological devices and systems such as particle accelerators and detectors that are developed by and used in CERN. There are full-scale experiments which are maintained, renovated or at the construction phase today as always being, or designed for future in CERN that is the biggest international scientific and technologic corporation organization of the world .

The science of physics goes far beyond Newton and Einstein and the particle physics is the future’s scientific field. In particular, the inventions, used in the diagnosis-purposed devices in medicine, indicate a new future. For this reason, our teachers should always upgrade their knowledge and should be ready for educating the 21st Century’s students. Turkey officially participated in CERN in 2014, and right after, the teacher Workshops were organized. Totally 229 teachers participated to six workshops that have been held in CERN where 150 Turks at PhD, post-doctorate degrees and executing the research from Turkish and foreign universities worked until today. In this article, the professional knowledge and experience acquisitions of teachers who attended the workshops in CERN laboratories on the base of innovation, entrepreneurship and technology in education, dissemination of knowledge by the teachers to other schools, colleagues, policy-makers and students when they come back to school. The article finalizes what should be done in this field for advance development.

## **CLASSROOM INTERACTION PRACTICES AND STUDENTS' LEARNING OUTCOMES IN PHYSICS: IMPLICATION FOR TEACHING -SKILL DEVELOPMENT FOR PHYSICS TEACHERS**

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Over the years, evidence in the science education literature seems to suggest that student-centred classroom interaction appears to have influence over and above teacher-centred interaction in enhancing learning outcomes in various science subjects or topics especially in Physics. Based on this premise, this paper therefore examined the influence of teacher-centred and student-centred interaction practices on students' achievement and attitude in dynamics, an aspect of Physics considered abstract at the secondary school level. This study employed both the quasi-experimental and observational survey designs. A sample of six schools from Kogi East Local Government Area of Kogi state, Nigeria were purposely selected from where 300 physics students from intact classes and ten teachers were involved in the study. Three instruments were developed and used for data collection. These are teacher-student classroom interaction observation schedule (TSCOS), Students' Attitude Questionnaire (SAQ), and Physics Achievement Test (PAT) with reliability indices of 0.68, 0.86 and 0.79 respectively. The data generated from the use of the instruments were analyzed using descriptive statistics of mean and standard deviation to answer the research questions raised, while the ANCOVA statistic was used to test the hypotheses at 0.05  $\alpha$ -level. Results of data analysis revealed that both the teacher-centred and student-centred classroom interactions do not influence student's achievement and attitude to dynamics. Also, gender was an influencing factor in dynamics when the topic being considered is abstract to students. It was recommended that teaching methods should not be advocated across board because not all the topics/contents could blend effectively with every method. Implications that were drawn for teacher skills acquisition were equally highlighted.

## LINKING SCIENCE AND TECHNOLOGY EDUCATION COMMUNITIES IN CHINA

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The importance of science and technology education has been recognized by many countries. In order to understand the “territory” of science and technology education in China. The following questions were explored: 1-Who are in science and technology education and with what capacity? 2-How are the stake holders in science and technology education connected in order to move the field forward? and 3) How to promote collaboration among science and technology education communities in China? and 4) How does the study inform similar studies across the world? The questions were answered first by literature studies using data from both academic papers and the Internet in both English and Chinese. Some organizations and representatives from those organizations were identified. Selected representatives from these organizations were interviewed in regard to the questions. Data were analyzed also in regard to the questions. The results revealed diverse groups of people and organizations who are related to science and technology education, such as the Ministry of Education that is responsible for formal science and technology education, CAST (Chinese Association of Science and Technology) that is responsible for informal science and technology education, and the National Association for Science Education, the Chinese Society of Education (NASE) that connects researchers and practitioners. Most organizations have limited influence internationally. More collaboration and synergy is needed in order to spend the country’s resources wisely and fulfill the goal of science and technology education.

The study provided knowledge about organizations and people in science and education in China and how they played their roles in moving the field forward. This will become a starting point for more idea sharing and proposals for strategies to initiate and strengthen collaboration among organizations and people who are in science and education in China. The study, then, provide a framework and methods for understanding the science and technology education communities across the world; this will then enable people to address global issues locally with sustained efforts, such as global warming, pollution, water shortage, wars, and the like.

## **A NEW LOOK AT SCIENCE EDUCATION IN EARLY CHILDHOOD? TEACHERS' PERCEPTIONS OF SCIENTIFIC CURIOSITY AND BEST PRACTICE EXAMPLES**

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Science learning does not start at secondary school, nor does it begin in primary school, or even preschool. It begins at birth; and each successive stage builds on these foundations. The most important people in the development of a child's cognition and emotions are the adults and older children with whom they come into contact. Teachers and other carers and family members support the child's exploration of the natural environment and scientific phenomena. Moreover, we are experiencing a paradigm shift in our understanding of science education in early childhood. In academic literature and at science education conferences, educators are increasingly discussing the early years of science learning - Why? Because cognitive science and neuroscience has revealed the high capacity of very young children to hypothesize, to predict, plan, manipulate variables, draw conclusions, and employ other skills needed for scientific investigation (Gopnik, 2012; Schulz, 2015). It appears, then, that children before formal school (particularly 1 to 5 yrs.) are intuitive scientists, and that adults are important mediators in this early critical stage of learning (Tunnicliffe & Ueckert, 2011). The careful participation of adults in the spontaneous observations and investigations of the very young can be a critical intervention in the positive development of a child's scientific literacy. This involvement means listening to their ideas, talking to them, cuing them to think further, and scaffolding them while they are investigating and experiencing. It does not, however, mean explaining the theory in old-fashioned formal teaching mode! Learning science should be based on hands-on, situated, physical experiences associated with language, numeracy and social skills like cooperation and communication. Studies also show that positive attitudes toward science at early stages, feeling curious to learn science and perceiving science as interesting are all factors that predict scientific engagement and achievement in the long run.

This talk will illustrate the importance of the earliest science encounters of children's life in the everyday world that they inhabit. In preschool and kindergarten, their observation and exploration can be helped or hindered by their teachers. We asked, what are preschool teachers' conceptions about the nature of scientific curiosity in children? A 'Conceptions about Children's Curiosity' questionnaire was administered to preschool teachers (Spektor-Levy, Kesner-Baruch, & Mevarech, 2013). The questionnaire consisted of six open-ended questions, to which teachers gave various comprehensive answers in two domains: 1. their ideas about and descriptions of the curious child and scientific curiosity; 2. their perception of what fosters curiosity. A total of 105 teachers responded to this questionnaire.

Qualitative data analyses revealed four main categories (each consists of sub-categories) that describe teachers' understanding and descriptions of the curious child and the ways to foster curiosity: emotional aspect, cognitive aspect, sensorimotor aspect, and social aspect. The presence of these four aspects implies that preschool teachers perceive the child as a 'whole'.



The whole-child approach is a comprehensive educational approach that supports students' excellence and equity by meeting their overall personal learning needs, such as health, safety and wellbeing, in addition to a providing a challenging and comprehensive curriculum. Although this approach may seem to be unrelated to science education, studies have shown that it supports effective science education in schools.

A comparison of the frequency of the quotes associated with each category in the two domains revealed differences that were confirmed by Chi-square tests of independence. For example: 64% of the teachers pointed out that the curious child expresses wonder and excitement, but only about 30% of the teachers mentioned their role in modelling and encouraging wonder and excitement. Eighty four percent of teachers indicated that a curious child needs to know more – and ask questions. However, only 22.8% indicated that they encourage the children in class to ask questions.

Following this survey, the teachers participated in a professional development program designed to support them in planning scientific activities that arouse curiosity and encourage exploration. In our talk we will present some of the activities and the children's responses. We will demonstrate young children's (age 4-5 years) high order scientific thinking, scientific curiosity, and inquiry competencies.

### References

- Gopnik, A., (2012). Scientific Thinking in Young Children: Theoretical Advances, Empirical Research, and Policy Implications. *Science*, 337, 1623-1627).
- Schulz, L. (2015). Infants explore the unexpected. *Science*, 348, 42-43.
- Spektor-Levy, O., Kesner-Baruch, Y. & Mevarech, Z. (2013). Science and scientific curiosity in pre-school – The teacher's point of view. *International Journal of Science Education*, 35 (13), 2226-2253.
- Tunnicliffe, S. D., & Ueckert, C. (2011). Early biology: the critical years for learning. *Journal of Biology Education*, 45(4), 173-175.

## **AN ANALYSIS OF PRIMARY TEACHER CANDIDATES' IDEAS ABOUT THE HUMAN BODY**

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The aim of this study is to investigate pre-service primary teachers' ideas about the human body, e.g. location, size/shape and presence of organs (heart, stomach and lungs etc.) This research was conducted with 104 primary teacher candidates studying in the Faculty of Education at Trakya University during the 2016-2017 academic year. The research data was obtained through the use of drawings and interviews with selected students. The findings revealed that the most frequently illustrated organs in the students' drawings were heart, lungs, stomach, liver, kidneys and intestines. However, a great deal of them was not scientifically acceptable e.g. in terms of location and size. There are many aspects in the drawings that need to be underlined by teachers in teaching-learning process.

## CRACKEN REFLEXIVE THOUGHT THROUGH BRACKEN

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The teaching experience (practicum) is one of the more challenging, positive, and significant aspects of pre-service teacher education. The importance of the coherence and integration between Initial Teacher Education (ITE) course work and practicum, together with the development during extended practicum periods of relationships, shared understandings and beliefs between schools and university faculty members that reflect the programme's vision of good teaching, are essential components of exemplary teacher education programmes. Course work and school practicum experience both influence and build student teacher capability. Bringing practitioner and academic knowledge together has the potential to create, "a transformative space where the potential for an expanded form of learning and the development of new knowledge are heightened" (Gutiérrez, 2008, p. 152). In the New Zealand context, the teaching experience should be situated in an inquiry stance and student teachers taught to be not only reflective but also adaptive experts who have the promotion of engagement, learning and well-being of all student learners as the basis of their professional identity.

This paper outlines an innovative approach aimed at meeting these challenges through the introduction of deliberate practice to develop student teachers as inquiring reflexive practitioners. The 60 student teachers enrolled into the 2016 one-year, course-taught, master's degree in primary or secondary education. As part of their course of study, they use a video capturing programme to facilitate development of reflexive thinking. Specifically, student teachers used capture video footage of their teaching practice for collaborative peer appraisal. The shared used of video promoted working within a community of practice, learning from one another and engaging in a manner designed to foster learning conversations, bringing meaningful linking of theory and practice. The study highlights how video capturing allowed student teachers to see, hear, and critically analyze through narratives with a community of practice (three to four other student teachers and the programme coordinator) what actually happened and not what was 'remembered'. The narrative threads of commentary available promoted the connection of ideas within class, within tutorials, and within schools improving their understanding of the network of relationships that exist within and across learning communities.

The results of this study highlight how video capture and its subsequent critical analysis is an approach that encouraged these student teachers to develop as agents of change by exposing them to the theoretical tools and practical experiences needed to critique and build on what they experienced.

## **THE VIEWS OF SCIENCE AND SOCIAL SCIENCES TEACHERS ON THEIR PROFESSIONAL DEVELOPMENT WITHIN THE STUDENT ACHIEVEMENT**

*Mustafa Hilmi Çolakoğlu, Şahin İdin*

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The aim of this study is to determine science and social sciences teachers' views, who work at science high schools and social sciences high schools, on their professional development in the scope of student achievement. For this purpose a survey was developed, which has validity and reliability, and it has 48 items. Firstly, the survey was prepared and sent to teachers that its items were understandable or not. Teachers sent their views on survey and needed corrections were carried out. Then two measurement and evaluation specialists looked into it. After it, needed corrections were carried out and after all, the survey was created. 540 science and social sciences teachers filled in the survey, and the teachers filled in the form on internet via using Google doc form. Descriptive, independent sample t test and one way ANOVA statistical techniques were used while data analyzing. According to findings, there are some different views between teachers, who work at science high schools and social science high schools, in the scope of survey items. While science high school teachers think that they can improve their professional development at their schools, social science teachers do not think it. At the end of the study, there are given some recommendations to the teachers.

## **MATHEMATICS AND SCIENCE FOR LIFE (MASCIL): THE NATURE OF PROFESSIONAL DEVELOPMENT**

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Mascil project promotes the more widespread use of problem and inquiry-based science teaching (IBST) in primary and secondary schools and bridge the gap between the science education research community, science teachers and local actors (including providers of informal science education). mascil professional development (PD) courses aim at supporting mathematics and science teachers in implementing inquiry-based science teaching that is informed by workplace practice in their day-to-day teaching. These courses help teachers support learners in a culture which values securing basic knowledge, working on substantial tasks, learning from mistakes, cumulative and autonomous learning, recognising subject boundaries within interdisciplinary approaches and cooperative learning.

In Turkey, more than 200 in-service science and maths teachers participated in the two-day mascil PD courses in different cities. The PD courses mainly focused on inquiry-based learning (IBL) in connection to the world of work (WoW). Following a first course, that took place earlier, the participating teachers implemented the mascil units in their classrooms. After this implementation phase, this second two-day course was organized to get to know more about their experiences during the implementation phase and to offer a platform for exchange. Selected teachers shared their experiences and informed about success and challenges they experienced while implementing mascil activities in their classrooms. It needs to be emphasised that many teachers expressed that the mascil professional development program had an important impact on their classroom practices.

## THE CHALLENGES OF TEACHERS ON THE USE OF DIGITAL TEXTBOOKS IN THE CLASSROOM IN ELEMENTARY SCHOOLS

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In recent years, content and digital textbooks are useful in promoting innovative pedagogy adapted to the 21st century. Educational institutions in most countries promoting this pedagogy, changing the methods of teaching, learning and assessment, as well as promoting computer literacy and information skills as an important element of the 21st century that granted to all graduate.

Digital textbook is a product that provides an interactive experience to the learner; it can be updated at any time, allows planning and organization of learning about the needs of the school and it expected to be a part of every classroom.

The digital textbook is based on the formal curriculum of the Ministry of Education in Israel in different subjects. The book will be accompanied by a teacher's guide, which is a tool for teacher's guidance wise consumption of digital content in a variety of modes of representation and the learning experience of teachers and their impact on the learning motivation, cognitive and effective high order thinking.

The new pedagogy for digital textbooks offer teachers who are used the paper textbooks a new challenge by a facing of using ways of interacting with massively shared, adaptive and dynamic books.

The teachers can be the key players in the successful implementation of digital textbook to foster a sensible, balanced solution in the convincing and ambient classroom environment.

This study examines teachers' challenges and difficulties for using digital textbooks in the elementary schools. In addition to investigate the changes in the perception of teaching, the role of the teachers who teaches through digital textbooks and the use of digital textbooks in the process of teaching-learning-assessment.

The participants of this study were 120 elementary school teachers who used digital textbooks in different subjects during the years 2013-2014. Data was collected through an online survey questionnaire sent to users via email.

The study used two statistical methods for data-processing: descriptive and referential, as well as content analysis. Results of each method of analysis are meant to confirm those of the other. Data was analyzed using SPSS 20 statistical package.

**ICASE JOURNAL: SCIENCE EDUCATION INTERNATIONAL**

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*China, Estonia, Turkey*

Science Education International is the quarterly journal of the International Council of Associations for Science Education (ICASE). It is important for all science educators and researchers to publish their studies as an article in a journal which indexed in valued databases. It is by means of the indexed publications that the research and the researcher can be widely recognized in the academic community and get reputation in science education arena.

The main aim of this session is to discuss how Science Education International should/can operate and investigate authors' needs. We might also take advantage of this opportunity to discuss how the ICASE research and publication committee's work. The planned duration is 2 hours or 3 hours.









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ISBN: 978-605-9226-81-3