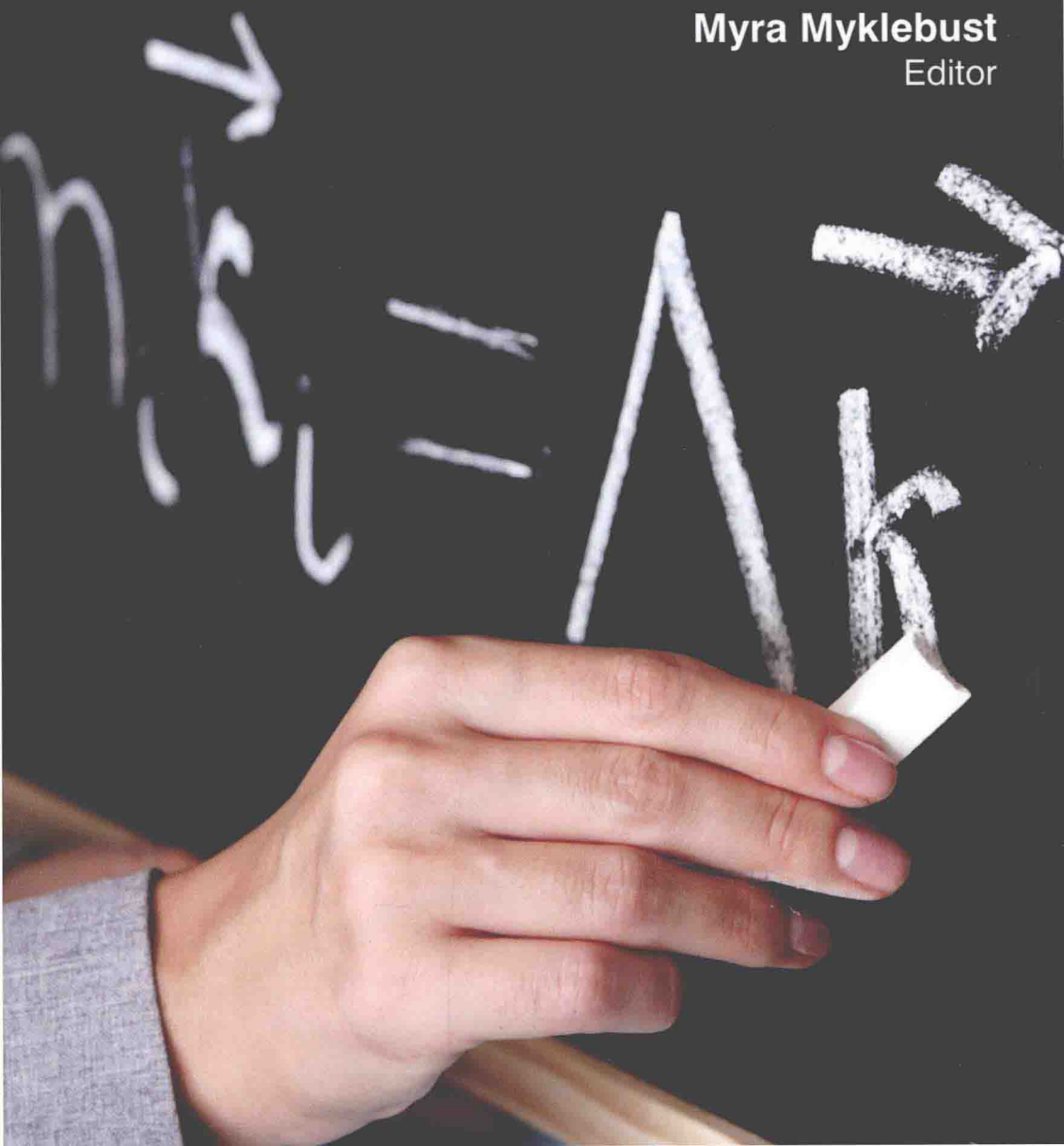
Innovations in Science, Technology, Engineering, and Mathematics Learning and Teaching

Myra Myklebust
Editor



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Dr Myra Myklebust

Norwegian University of Life Sciences, Norway

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Preface

STEM fields or STEM education is an acronym for the fields of study in the categories of science, technology, engineering, and mathematics. The acronym has been used regarding access to United States work visas for immigrants who are skilled in these fields. It has also become commonplace in education discussions as a reference to the shortage of skilled workers and inadequate education in these areas. The initiative began to address the perceived lack of qualified candidates for high-tech jobs. It also addresses concern that the subjects are often taught in isolation, instead of as an integrated curriculum. Maintaining a citizenry that is well versed in the STEM fields is a key portion of the public education agenda of the United States.

The exact definitions of what is within the purview of STEM, and what is excluded, varies from organization to organization. In 2012, the United States Department of Homeland Security (DHS) announced an expanded list of science, technology, engineering, and math (STEM) designated-degree programs that qualify eligible graduates on student visas for an optional practical training (OPT) extension. Under the OPT program, international students who graduate from colleges and universities in the United States are able to remain in the country and receive training through work experience for up to 12 months. Students who graduate from a designated STEM degree program can remain for an additional 17 months on an OPT STEM extension. STEM generally supports broadening the study of engineering within each of the other subjects, and beginning engineering at younger grades, even elementary school. It also brings STEM education to all students rather than only the gifted programs. In his 2012 Budget, President Obama renamed and broadened the "Mathematics and Science Partnership (MSP)" to award block grants to states for improving teacher education in those subjects.In an attempt to broaden this topic here are some notes from the National STEM Centre of the

UK: The National STEM Centre houses the largest open collection of resources for teachers of science, design and technology, engineering and mathematics in the UK. Alongside contemporary resource materials including print, multimedia and practical resources, is a growing archive collection which showcases several decades of curriculum development. In the State of the Union Address on January 31, 2006, United States President George W. Bush announced the American Competitiveness Initiative. Bush proposed the initiative to address shortfalls in federal government support of educational development and progress at all academic levels in the STEM fields. In detail, the initiative called for significant increases in federal funding for advanced R&D programs (including a doubling of federal funding support for advanced research in the physical sciences through DOE) and an increase in U.S. higher education graduates within STEM disciplines. Project Lead The Way (PLTW) is a leading provider of STEM education curricular programs to middle and high schools in the United States. The national non-profit organization has over 5,200 programs in over 4,700 schools in all 50 states. Programs include a high school engineering curriculum called Pathway To Engineering, a high school Biomedical Sciences program, and a middle school engineering and technology program called Gateway To Technology. PLTW provides the curriculum and the teacher professional development and ongoing support to create transformational programs in schools, districts, and communities. PLTW programs have been endorsed by President Barack Obama and U.S. Secretary of Education Arne Duncan as well as various state, national, and business leaders. "The Science, Technology, Engineering, and Mathematics (STEM) Education Coalition works to support STEM programs for teachers and students at the U. S. Department of Education, the National Science Foundation, and other agencies that offer STEM related programs."

This volume has significant research analysis drawn from teachers and researchers spread out both in and outside India. It is estimated that the book will optimistically gratify the prospects of the connoisseurs of the challenges and innovations in education.

—Editor

Contents

Chapter 1

Innovations in Teaching and Learning Process

Basic Concept of Play-way Learning

Play way in education aims to introduce the spirit of play in all educational institutions. The methods and techniques used for imparting education must be able to create an environment in which the child can learn his lesson or acquire the desired knowledge.

Importance of Play in Education

Education should be fun and not forced. Any activity done in a spirit of fun is not work at all; on the other hand, activities in which the spirit of play is forced or absent should be considered work.

We know the spirit of childhood is play and thus play-way in education insists on child centered education. It advocates educating children through activities in which children can put their heart and soul and work in an atmosphere of freedom and spontaneity. The modern methods of teaching like kindergarten method, Montessori Method, Dalton –plan, Heuristic method, Project method and our craft centered basic education are all attempts to imbibe play spirit in education. Activities undertaken in school in the form of hobbies, dramatization, scouting, girl guides, self government, excursion and other curricular activities teach the important concept that for education to be most effective, education should be fun and not forced. Educational games serve a good purpose in this direction.

For example stage play can be used for history and mother tongue. Mathematical games can be used to learn or practice various mathematical facts. We can arrange competition between groups in the class or between different classes in the school and thus make the children interested in knowing so many things of general interest or related with some specific subjects. In this way play can be used as an effective medium or platform for imparting valuable education to our youngsters. Not only does it pave the way for imparting effective and enduring education; it helps in realizing the broader aims of education. It helps bring the harmonious development of the personality of children by taking care of their physical, mental, emotional, social and moral development.

It also provides opportunities for the modification of their behavior and prepares them for getting adjusted to their environment and life. Thus play and the play way can be regarded as an effective means of educating children.

Sensory Training

Children who would most benefit from Sensory Modulation Training are:

- children who do poorly on the Greenspan Infant/Child Regulatory Patterns Survey
- overly sensitive to touch, movement, sights or sounds
- under-reactive to touch, movement, sights or sounds
- easily distracted
- experiencing social and/or emotional problems
- unusually high or unusually low in level of activity

- physically clumsy or careless—poor motor planning
- impulsive and lacking in self-control
- experiencing difficulty making transitions from one situation to another
- experiencing delays in speech, language or motor skills
- delayed in academic achievement

What is Sensory Modulation?

Sensory modulation is when the senses work together. Each sense works with the others to form a composite picture of who we are physically, where we are and what is going on around us. Sensory modulation is a neurological function that is responsible for producing this composite picture. It is the organization of sensory information for on-going use.

Typically healthy sensory modulation occurs automatically, unconsciously and without effort in normally developing children. For children with a variety of developmental challenges, the process is inefficient, demanding effort and attention with no guarantee of accuracy. When this occurs, the goal to regulate sensory input and to "make sense of the physical world" and the "place of self within that world" is not easily attained.

Sensory experiences include touch, movement, body awareness, sight, sound and the pull of gravity. The process of the brain organizing and interpreting this information is often called sensory integration or sensory modulation. Sensory modulation provides a crucial foundation for later, more complex learning and behavior.

For most children, sensory modulation develops in the course of ordinary childhood activities. Motor planning ability is a natural outcome of the process, as is the ability to adapt to incoming sensations. But for some children, sensory modulation does not develop as efficiently as it should. When the process is disordered, a number of problems in learning, development or behavior may become evident.

If you have the availability of Occupational Therapists who are trained in Sensory Integration Assessment and Intervention it would be best to contact them first to assess your children prior to providing sensory modulation training. This will insure that the sensory modulation programs designed for the children meet their needs without overloading or overwhelming them.

However we recognize that not all communities, schools or agencies have the availability of Sensory Integration trained therapists and for this reason this site presents ideas for parents and teachers which hopefully will assist children to lessen their unhealthy responses to sensory stimuli. Hopefully this site and its information will stimulate you to seek out Sensory Integration trained therapists to take up work in your community, school or agency so as to provide your children with the appropriate sensory modulation training they need.

To guide children through a number of activities that challenge their ability to respond appropriately to sensory input and make a successful, organized response. These sensory stimulating experiences hopefully through repetition and continuous exposure allow children to become more capable of adjusting to sensory input and to regulate both their physical and emotional responses to these sensory stimulations. This process encourages self-regulation of sensory input and improves the children's ability to respond to the world of sensory input in a more adaptive way. This activity allows children to feel comfortable with the sensations of this world and to cope with how their bodies respond to these sensations.

Making sensory modulation training fun and playful motivates children to participate more fully in these activities. Most children tend to seek out activities that provide sensory experiences that are most beneficial to them at their current physical, emotional and social

development. It is this active involvement and exploration that enables children to become more mature, efficient organizers of sensory information, and thus more relaxed with their experience of the sensory input of the world.

Joyful Learning

The Karnataka government and UNICEF collaborated to create a virtual revolution in education in Mysore district.

The walls in classrooms are hung with colourful charts and craftwork. Children of different are ages sitting in groups. A child mimics birdcalls. This is a classroom in a government school. And today's lesson is about 'Environment'. But there is no 'teacher' here; only a 'facilitator'. And that is not just a meaningless change of nomenclature.

Government schools normally shy away from any change in modes of teaching or learning. Nali-Kali is an exception, having created a veritable revolution in classroom transactions. Nali-Kali or 'joyful learning' was started as an experiment in classroom transaction, spearheaded by the teachers themselves. It all began in Heggada Devana Kote taluk in Mysore district. UNICEF had prepared a micro-plan, which included a survey of in-school and out-of-school children in the taluk, a primarily SC/ST constituency. In 1995, M N Baig, Education Officer in Mysore district, along with UNICEF and the Commissioner of Public Instruction, decided to revive the micro-plan and look into activity-based learning. They held a meeting with

schoolteachers in the taluk. The local teachers isolated some problems that they could tackle themselves. These included absenteeism of children involved in farm labour, unattractive curricula and teaching methods, lack of support at home and urban bias in textbooks.

The pre-training session, consisting of 35 teachers, resource persons and other officials laid down outlines for classroom transactions, teaching-learning materials, etc. Learners' problems, especially those of first-generation learners, were discussed, the minimum level of learning scrutinized and changes suggested. The learning load was reduced to a realistic and achievable level. Language, mathematics and environmental studies were to be taught through art, craft, song, dance and other activity-oriented methods.

Nali-Kali envisions the breaking down of the traditional hierarchy that exists between teacher and student. This orientation is introduced at the level of training of the teachers itself. All the teaching learning materials are handmade by the teachers and hands-on experimentation is encouraged. In the first year, 1995, 257 teachers from HD Kote were trained. This number rose to 322 in 1999. It is operational in all but one block in Mysore district. In addition, five blocks across the state were also covered.

Nali-Kali has managed to penetrate the villages in unprecedented ways. In Madanpura, the private school had to close down because most of the students sought a transfer to the government school! And even the farmers were heard humming the action songs that are taught in the school.

The Nali-Kali method of classroom transaction not only gives a greater autonomy to the teacher but also creates the right atmosphere for the child to learn in a friendly and joyful way. Learning takes place systematically in groups organized according to age wise competencies in an interactive manner.

When children master the competency of one group, they move on to another group to learn the next competency. The teaching takes place through songs, games, surveys, story telling, use of educational toys and improvised teaching-learning materials, allmade by the teachers themselves.

Activity-Based Learning (ABL)

The aim of Activity-Based Learning (ABL) is to change the teacher from an authority in knowledge to a facilitator for the student to discover knowledge. When anyone experiences interest in something, whether it is a subject, sport or activity, nothing will stop him or her from learning all they can about it. Academic subjects can also be introduced from an interesting perspective, where fun is a gateway for learning.

The teacher changes from authority to facilitator by finding ways to present a syllabus that is based on fun. Many types of games and activities can be modified for school use and once children understand and enjoy the games, they will create games for themselves and other classes. Whether through play or through games created for learning, children automatically remember the subject involved. Just because children and teachers are enjoying the games does not mean that the

subject matter gets lost; on the contrary, the subject matter is the starting point.

ABL gives joy to children, and teachers have the satisfaction of imparting a life-long love for learning. The following topics will be covered in the training:

1. A clear idea of the aim of ABL
2. How to present ABL to a class
3. Materials and methods for ABL
4. How to make ABL relevant to the students
5. How to reinforce what was learned from ABL
6. How to involve the children in creating and implementing ABL.

ALM

The Sarva Shiksha Abhiyan (SSA) has introduced Active Methodology, a new teaching method, for Standards VI to VIII in 10 schools at Ayodhyapattinam block in the district on a trial basis this academic year.

The new method is aimed at ensuring quality in the middle schools and improving the level of understanding of the students.

Concept

Officials with Sarva Shiksha abhiyan said that Active Learning Methodology is primarily based on 'SQ4R' concept, which lays