**Summary of the Best Practices and Innovations in the Teaching and Learning of Mathematics in the Represented APEC Economies**

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| Title | : | **Summary of the Best Practices and Innovations in the Teaching and Learning of Mathematics** |
| Presenter | : | Prof. Dr. Nerida F. Ellerton |
| Date and Time | : | 13 August 2003, 3.13 p.m. - 4.15 p.m. |

1. **Content of the Paper**

**Best Practices and Innovations in the Teaching and Learning of Mathematics**

# Defining Best Practice

**Some guiding principles:**

- Best practice is not the same the world over
- Best practice needs to be developed at the school level
- Models of best practice need to be shared
- Best practice needs to be valued at all levels - school, community, district, state, national, international

# Best Practice Involves

- Listening to the voices of children
- Designing a child-centred curriculum
- Children enjoying learning
- Doing to understand - active learning
- Relating learning to the world of the child
- Teachers as learners
- Providing professional development

## Similarities and Differences in Cross-Cultural Contexts

**Curriculum**

- Australia : State frameworks
- Japan: National Curriculum
- Korea: National Curriculum
- Malaysia: National Curriculum
- Singapore: National Curriculum
- United States: School-based Curriculum

## Similarities and Differences in Cross-Cultural Contexts

**Textbooks**

- Australia: Wide choice of commercial texts
- Japan: Government texts
- Korea: One national textbook
- Malaysia: Government approved texts
- Singapore: Choice of three MOE approved texts
- United States: Choice of state approved texts

## Similarities and Differences in Cross-Cultural Contexts

**Language of Instruction**

- Australia : English
- Japan: Mother Tongue
- Korea: Mother Tongue
- Malaysia: BM, English (Pr 1, F1, L6), mother tongue in national-type schools
- Singapore: English
- United States: English

## Similarities and Differences in Cross-Cultural Contexts

**Class Size**

- Australia: 25-30
- Japan: 30-40
- Korea: 45-55
- Malaysia: 35-50
- Singapore: 35-40
- United States: 25-30

## Similarities and Differences in Cross-Cultural Contexts

**Predominant Mode of Instruction**

- Australia : Varies
- Japan: Cooperative Groups/Whole class
- Korea: Whole class instruction
- Malaysia: Whole class instruction
- Singapore: Whole class instruction
- United States: Varies

## Similarities and Differences in Cross-Cultural Contexts

**Use of Concrete Materials**

- Australia: Widely used
- Japan: Frequent use
- Korea: Frequent use
- Malaysia: Sometimes used
- Singapore: Increasing use
- United States: Widely used

# Similarities and Differences in Cross-Cultural Contexts

**Support for Slow Learners**

- Australia : Integration, with extra support
- Japan: Juku for all learners
- Korea: Extra classes in vacation time
- Malaysia: After school classes
- Singapore: Learner Support Program
- United States: Integration

# Similarities and Differences in Cross-Cultural Contexts

**Technology in Classroom**

- Australia: Varies across states
- Japan: Varies
- Korea: Internet access in every classroom
- Malaysia: Moving towards ICT
- Singapore: Varies across schools
- United States: Varies across schools

## Similarities and Differences in Cross-Cultural Contexts

**Calculators**

- Australia : Yes
- Japan: Classroom but not in exams
- Korea: No
- Malaysia: No
- Singapore: No
- United States: Yes

## Similarities and Differences in Cross-Cultural Contexts

**National Evaluation**

- Australia: State/Territory Benchmarking
- Japan: End of Primary
- Korea: Grade 3 (not high stakes)
- Malaysia: End of Primary
- Singapore: Pr 6; Sch-based streaming Pr 4
- United States: State-wide Grade 4

## Similarities and Differences in Cross-Cultural Contexts

**Professional Development**

- Australia : Varies across states
- Japan: Local Study Groups
- Korea: Not centrally organised
- Malaysia: Emphasis on key teachers
- Singapore: 100 hours for all teachers
- United States: Minimum credit hours

## Similarities and Differences in Cross-Cultural Contexts

**Parental Support**

- Australia: Moderate
- Japan: Very high
- Korea: Very high
- Malaysia: Varies
- Singapore: Very high
- United States: Moderate

## Similarities and Differences in Cross-Cultural Contexts

**Tuition**

- Australia : Few children tutored
- Japan: Major industry
- Korea: Major industry
- Malaysia: Major industry
- Singapore: Major industry
- United States: Few children tutored

**The comparisons drawn reflect the complexity of teaching-learning contexts in different countries.**

**Best practice must take account of the teaching-learning context. Because these contexts vary so widely within and across countries, best practice cannot be generalised.**

**But we can learn much from each other .......**

## Models of best practice need to be nurtured and shared

- within schools
- within districts
- within states
- nationally
- across countries

**Through sharing and discussing ideas, teachers become aware of possible best practices.**

**Teachers can then incorporate new ideas into their current practice and evaluate the effectiveness of these new ideas in their own classrooms.**

**Summary of The Best Practices And Innovations In Science Education In The Represented APEC Economies**

For the past two days, APEC member economy members share expertise and experiences in making the teaching and learning of science a success in their respective countries and situations. The seminar aimed at looking at learning from the experiences and challenges faced by our counterparts from other countries.

To summarize our experiences for the past two days, we would like to answer the following questions:

- What are the best practices presented?
- How do we operationalize best practices in the classroom?
- What are the support systems for these practices?
- How do we sustain and make the best practices better?

The first question can be answered through the examples cited during the presentations. The science group agreed that the best practices recognize the true goals of science education in each country and is responsive to the realities of the respective educational systems. The best practices should allow access to quality and up to date information and should respect and value the individual differences and needs of all students. The best practices maybe different from one economy to another but we should be able to discern which of these practices are relevant and should be adapted or adopted depending on our needs and resources. The best practices discusses range of useage of the specific teaching strategies for public advocacy means to national in-service training programs.

The best practices manifested in the classroom through strategies/activities, involve the students and allow them to learn the concepts experientially. The learning of science shown to be hands-on, hearts-on and minds-on. Science or the learning of it was presented as fun, which results to understanding how things come about. Classrooms are venue for students to explain the things they see according to the scientific concepts behind the occurrences. The science in the classroom addressed the needs of everyday lives of our children. Activities presented considered the different learning styles and intelligence of the students. Scientific literacy was focused on addressing the issues at hand and the specific needs of our students in the classroom. Classrooms offer students the opportunity for learning together while keeping their individually. Consequently, this brings us to the emerging issue of "indigeneity". An issue which is very crucial but is not properly addressed by the seminar this time.

How do we make classrooms to provide the ambience described above? The practices presented a concerted effort among the different stakeholders in making science education more interesting and inviting. Among the system supports presented are the interventions provide by the governments through educational projects, which focus on the development of human resource, which are responsive to the specific needs of the systems. Vital to the support given by the government sector is their level of commitment in making the programs successful. Government agencies also resort to policy changes, which support the improvement of instruction by adopting curricular reforms. Private entities with the help of the academe provide support through the popularization and promotion of science advocacy via science centers, which provide both fun and knowledge to students, teachers and the general public. Professional organizations also contribute to the promotion of the science culture by providing professional enhancement for member teachers. One participant specifically mentioned about the mentoring and modeling approach they use in improving the classroom management capabilities of the teachers. Training support for teachers should focus on ways to let teachers know what they don't know and allow them to find ways to develope and enhance their knowledge and skills. An education system which allows the teachers to identify their needs and involves them a part of the body which decides on the best solution and options to take plays as a vital part in creating a strong support in improving the teaching-learning environment.

How do we sustain and make these practices better? An efficient monitoring and evaluation of the practices presented is a must! Key success indicators should be properly identified and a monitoring scheme developed to guarantee an objective perspective of the progress and status of the programs. The impact of the programs/practices should be translated into terms of student achievement and assessment should focus on learning and understanding. Assessment results should also be used to support decision making on the improvement of teaching and learning environment. We actually talking of a complete paradigm shift in looking at science education. The practices presented may not be considered best but for now, they are the best we can do to address the challenges posed before us. Maybe, we can try them out and the next time, we can talk about which of those presented before us are best in our respective organizations and situations.

**What are the best practices in teaching and learning science?**

- Best practice is honest practice, recognising each country's resources.
- Recognising the true goals of science education in each country.
- Access to high quality up-to-date resources.
- Science education values/respects individual differences and addresses learning needs of all students.

**How to carry out the best practices in classrooms?**

- Use of analogies for explanation of scientific concepts – informed use and understanding their limitations.
- "Indigeniety" – an emerging issue.
- Misconceptions – identifications and addressing.
- Relevance of science to everyday lives – scientific literacy.
- Immediacy – just in time rather than just in case addressing issues.
- Student initiated science.

**What are the support and training systems?**

- Training and support provision for elementary science teachers.
- INSET needs to address teacher knowledge - primary teacher "don't know what they don't know" activity-based science.
- Modeling/coaching to make sustainable changes to practice.
- Strong professional organisations for science teachers.
- Support organization e.g. science centers provide impetus for change.
- Mobile/van go to individual school.
- Change management (reforms).

**How to assess best practices?**

- Assessment of student achievement and assessing for learning/understanding.
- Evaluation and monitoring of the system identifying key success factors and needs.

# Best Practice and Innovations in Science Education

**The Science Group**

- Drs. T. Subahan M. Meerah, Lilia Halim and Abd. Rashid Johar
- Dr. Michael M. Gore
- Ms. Cleofe S. Velasquez-Ocampo
- Drs. Otto Hammes and Husaini Wardi
- Ms. Ann Northover and Ms. Sue Leslie
- Dr. Susan Mary Stockimayer
- Ms. Patricia Lopez Stewart
- Dr. Azian T.S. Abdullah

# Questions we want to answer:

**What is best practice in science education?**

- Recognizes the true goals of science education in each country
- Responsive to the needs and constraints of the respective education system
- Provides access to quality up to date information
- Values and respects individual differences and addresses learning needs of all students
- Integrates and respects local cultures

## How do we operationalize best practice in the classroom?

- Learning founded on constructivism
- Learning concepts experientially
- Fun learning
- Learning through understanding
- Learning which considers learning styles and multiple intelligences
- Learning which is focused on issues of relevance to the students and on students specific needs.
- Learning together
- Teaching which takes note of research (e.g. analogies, Alternative conceptions)

**When I hear, I forget**
**When I see, I remember**
**When I do, I understand.**

**Lao Tse**

# How do we sustain and improve best practice?

**System**

- Evaluation and monitoring
- On-going quality professional development
- Popularization/promotion of science
- Professional organizations
- Policy and curricular reforms

**School**

- Basing decision on quality assessment information
- Assessment for learning
- Mentoring and modeling
- Professional support and clustering

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| Title | : | **Do-Talk-Record: A Teaching Sequence for Developing Mathematical Thinking** |
| Presenter | : | Dr. Ng Swee Fong, University of Malaya |
| Date & Time | : | 13 August 2003, 11.30 a.m. – 12.30 p.m. |

## 1. Content of the Paper

1.1 The presenter discussed the role of teachers as Learners in-service programmes.

1.2 Framework for Mathematical Problem Solving

- Concepts - Numerical, geometrical, algebraic, statistical
- Skills - Estimation & approximation, mental calculation, communication, use of mathematical tools, arithmetic manipulation, handling data
- Attitudes - Appreciation, interest, confidence, perseverance
- Processes - Thinking skills Heuristic
- Metacognition - Monitoring own thinking

1.3 The presenter discussed teacher's beliefs and support structures, teaching framework (CAP or concrete pictorial abstract), structure of talk, the helix underpinning Do-Talk-Record strategy which is manipulating – getting a sense of-articulating-manipulating-getting a sense of-articulating.

1.4 Class activity using coins and straws

| Figure | # of Counters | |
|---|---|---|
| 1 | 1 | |
| 2 | 3 = 1+2 | Forward Rule |
| 3 | 6 = 1+2+3 | |
| 4 | 10=1+2+3+4 | |
| 5 | 15=1+2+3+4+5 | |
| 6 | 21=1+2+3+4+5+6 | |

- Using the concept of "area" to generate forward rule. E.g. number of coins for Fig 100 = _ (99x100)
- Crossroad problems.

1.5 In the conclusion, the presenter emphasized that the introduction of new initiatives must be supported by suitable in-service courses and that teachers require time to engage new initiatives.

## 2. Discussion

2.1 *Dr. Parmjit Singh of Universiti Teknologi Mara, Malaysia* asked at what level are Singaporean students first introduced to these activities.