Key Action 2 – Erasmus+ Strategic Partnerships for School Education
Cooperation for Innovation and the Exchange of Good Practices

ENHANCING DIFFERENTIATED INSTRUCTION AND COGNITIVE ACTIVATION IN MATHEMATICS LESSONS BY SUPPORTING TEACHER LEARNING (EDUCATE)

Educational Studies Association of Ireland

6 April , 2018

IRISH TEACHERS' NEEDS AND CHALLENGES WITH DIFFERENTIATION AND COGNITIVE DEMAND IN MATHEMATICS

Seán Delaney, Damien Burke, Ann Marie Gurhy & Mark Prendergast

Funded by the
ERASMUS+ Programme
of the European Union

Educate
Erasmus+KA2

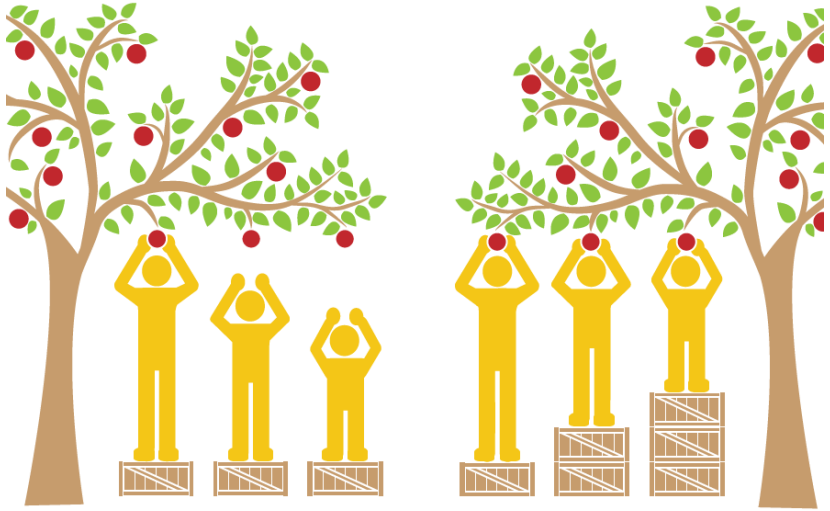
ACKNOWLEDGEMENTS

- **This project, entitled "Enhancing Differentiated Instruction and Cognitive Activation in Mathematics Lessons by Supporting Teacher Learning (EDUCATE)", has been funded with support from the European Commission. This publication [communication] reflects the views only of the author(s), and the Commission cannot be held responsible for any use which may be made of the information contained therein.**

Erasmus+

Values and Purpose in Education

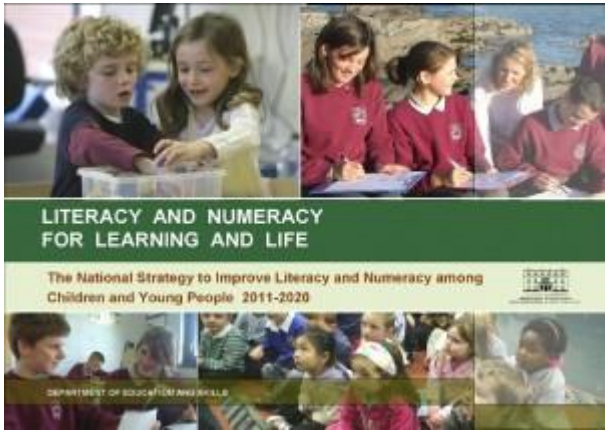
Pursue Excellence



Promote Equity

Policy Context of Study

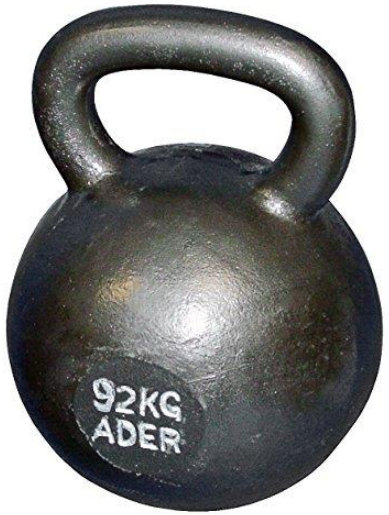
Literacy and
Numeracy Strategy

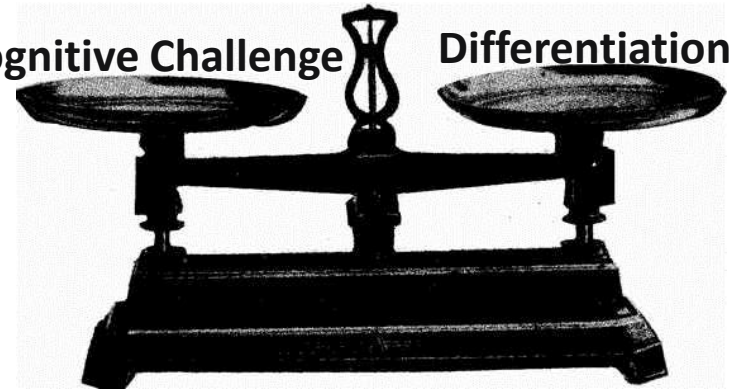


(Project) Maths
New Junior Cert Framework
Consultation process on draft new mathematics curriculum (junior classes)

Background


MY MIND SAYS
GYM
PIZZA


92KG
ADER


Cognitive Challenge
Differentiation


04
08
20
16
12

Research Questions

- What practices related to differentiation and cognitive activation were identified by and observed in mathematics lessons taught by a small, convenience sample of Irish teachers?
- What challenges were identified or observed in teaching such lessons?
- What would help these teachers teach mathematics lessons in which instruction was differentiated for all students and where the cognitive demand for all students was high?

Participants

Teacher	Level	Pre-service /Inservice	Experience or Qualifications	School
Mary	Primary (1st class)	In-service	10+ years. Co-authored math textbook	All girls; 450 students; Dublin; not serving disadv area
Alan	Primary (5th & 6th)	In service	NQT. Particularly interested in math teaching	All boys; 140 students; small town; not serving disadv area
Paul	Primary (1st class)	In-service	11 years. Started M.Ed. In Sept; did leadership course	All girls; 438 students; large town; mixed SES & Ethnicity
Clare	Primary (4th class)	In-service	Fourth year teaching. Completed M.Ed. degree	All girls; 438 students; large town; mixed SES & Ethnicity
Conall	Primary (5th class)	In-service	2nd year teaching.	Co-educational; 239 students; large town; not serving disadv area
Susan	Primary (2nd class)	In-service	NQT	All girls; 220 students; Dublin; Servicing disadv area
Eoin	Primary (1st class)	In-service	NQT	All girls; 220 students; Dublin; Servicing disadv area
Carol	Secondary (1st Year)	In-service	3rd year teaching	All boys; 450 students; Dublin, private school
Lynne	Secondary (2nd Year)	Pre-service	In Year 2 of PME programme	Co-educational; 350 students; Dublin; private school

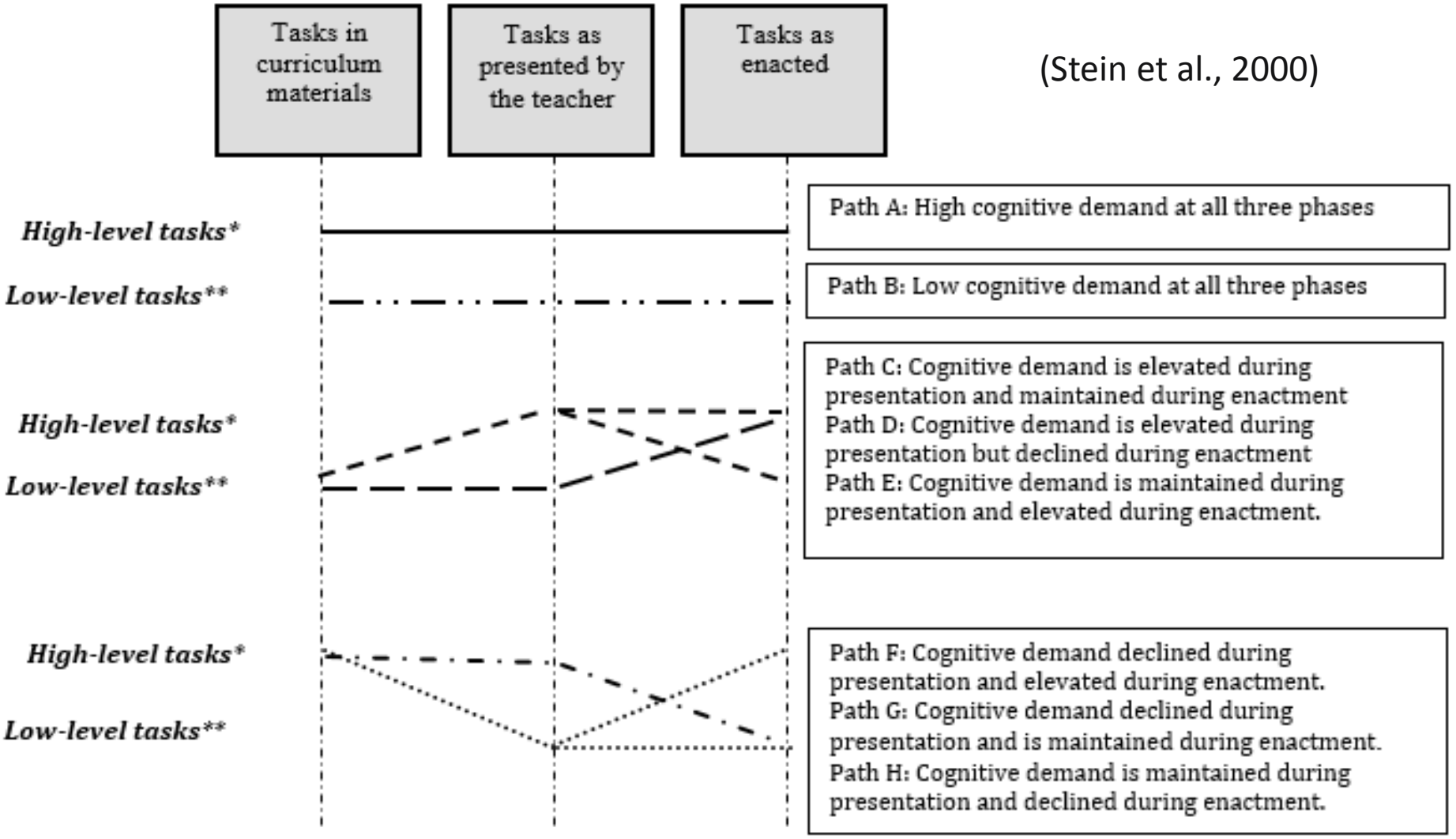
Data Collection

- 2 Lessons each
- Lessons videotaped
- Teacher wore lavalier microphone
- Interviews before and after each lesson, with common interview protocols

Data Analysis

- Each lesson analysed in depth.
- Key tasks in lessons identified and analysed using Task Analysis Guide (Stein, Smith, Henningsen, & Silver, 2000)
- Differentiation practices – content, process, product (Stradling & Saunders, 1993; NCCA, 2007)

(Stein et al., 2000)



* **High-level tasks:** Doing Mathematics (DM) and Procedures with Connections (PWC)
** **Low-level tasks:** Procedures without Connections (PWOC), Memorization (M), and Unsystematic Exploration (UE) (UE applies only to task enactment).

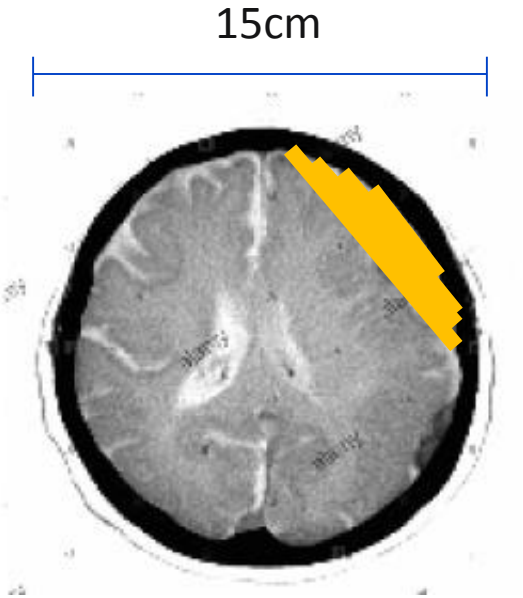
Methodology for Analyzing the Lessons to Identify Instances of Differentiation

- **Content**:
  - Are different students given different tasks/variations of the same task to work on?
  - How is the task presented? (are students offered multiple entry points?)
- **Process**:
  - Are different students given different ***materials*** to work on?
  - ***Attention/support***: Does the teacher attends/supports students in different ways?
  - Does the teacher pose different types of ***questions*** to engage more students?
  - ***Student organization***: do students work individually or in groups?
  - ***Level of autonomy:*** Are students given choice?
  - Does the ***feedback*** given differ by students?
  - Do ***assessment activities*** differ by students?
  - ***Lesson pacing***: Is there variation among students in terms of the time given to complete the work?
  - ***Classroom norms***: can students share/discuss solutions? Does the teacher adopt an evaluative stance that "closes" the discussion?
  - ***Levels of participation in the discourse***: teacher encourages students of different levels to participate (not necessarily share their solutions)
- **Product**:
  - ***Types of products expected from students:*** do they differ?
  - ***Multiple solutions***: Does the teacher encourage multiple solutions/multiple presentation of solutions?
  - ***Sharing/discussing solutions***: Are different solutions shared? Are the best solutions shared only?

(Stradling & Saunders, 1993; NCCA, 2007)

Example of Data Collection

Task: The picture shows a CT scan of the brain of a patient with a tumour. Find an approximation of the area the tumour (highlighted in yellow).



Show video clip from 14.30 – 16.30

Findings: Differentiation

Differentiation is a **bigger priority** for teachers on a daily basis than is raising cognitive demand.

- Strategies for differentiation varied according to:
  - Context
  - Time
  - Resources (staffing, materials)
  - Image of teaching ("It never struck me that there was another way of doing it")

Strategies Used for Differentiation

Differentiation by:

- Grouping
- Expectation
- Questioning
- Problem type
- Plenary discussions

Discussion & Conclusions: Differentiation

- **Multiple ways of differentiation:**
  - By expectation, questioning, varying level of difficulty, having plenary discussions, using concrete materials
- **Grouping practices varied:**
  - Possible parental opposition; prompts, remediation & extension from circulating teacher
- **Support from colleagues or assistants:**
  - Helped when available
- **Images of teaching:**
  - Make models of differentiated teaching available to teachers as inspiration for change
- **Resource bank would help**

Results: Challenges of Cognitive Activation

- **Awareness and sensitivity:** lagging behind differentiation
- **Task Availability:** textbooks, assigned curriculum content and standardized testing restrict teachers
- **Language**: Students need access to formal/advanced mathematical language to communicate and build precision
- **Challenging tasks challenge**: students may rely on previous (less efficient strategies) or may give up

Results: Supports for Cognitive Activation

- Having a range of **textbooks*** with suitable tasks (low threshold, high ceiling)
- Checklists or ways to quickly **profile student knowledge & readiness** and match to task
- Create a **challenge-rich classroom environment** (expect multiple solution strategies, respectfully critique peers' work, exploiting class polls of agreement/disagreement)
- **Teachers' receptiveness** to student questions and ideas is critical for maintaining/raising task cognitive demand
- **Topic**: Cognitive activation potential of some topics *may* be richer than others

Overall Learnings: Cognitive Demand & Differentiation

- **Teacher Priority:** possible role of our project
- **Teacher's needs:**
  - **Assessing the task:** Expertise needed to accurately ascertain this
  - **Assessing the students:** Need to quickly determine which students have necessary prior related knowledge for task
  - **Logistical supports:** Suitable tasks/concrete tools/profiling tools/ collegiate in-class support
- **Teacher (mathematical) knowledge:** support needed for teachers to anticipate and engage with students' ideas
- **Time and Resources:** Demanding; possible case studies of practice
- **Forum:** Where/how can teachers communicate with each other on such matters?

Thanks

- A word of thanks to all the teachers and student teachers who volunteered to participate in the study to date.

Thank you for your attention!

Contact details:

Website:
http://www.ucy.ac.cy/educate/en/

Email: sean.delaney@mie.ie

Sources of Images

- https://www.pdhpe.net/wp-content/uploads/2016/09/equity.png
- http://www.balendu.com/content.aspx?id=1303170 14704010600
- https://www.sthenosathletics.com/programs.html
- https://www.amazon.com/dp/B0011EMVOC//ref=cm_sw_su_dp?tag=chalit-20
- http://www.escapefitness.com/uk/studio-kettlebells.html
- http://bernard.thinsselin.free.fr/images/roberval.jpg