Learning about the effectiveness of EU structural fund projects in Italian schools

A large scale RCT for math teachers

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ITALY
European Structural Funds 2007/2013

The Italian Ministry of Education manages two National Operational Programmes (PON) funded by European Structural Funds and dedicated to 4 Regions in the South of Italy.

The two programmes are

- ESF PON “Competences for development”
- ERDF PON “Learning Environments”
Trying to raise low math achievement in Italy …

The weakness of Italian students in mathematics and science is confirmed by various national and international sources (i.e., IEA-TIMSS, OECD PISA, INVALSI).
... and to reduce the North/South gap, which increases over grades

*Difference from national average in the percentage of correct answers in grades 2, 5, 6 and 8. Source: INVALSI*
Special focus on professional development of teachers

In Italy:

- the average age of Italian teachers is one of the highest in Europe
- most teachers do not have specific training in teaching (compulsory initial training only since 1999/2000)
- in service teacher training is not compulsory
- they rarely attend training opportunities; do not have salary differentiation based on merit; declare they would like to have more feedback about their job [Talis 2008].
- most math teachers did not graduate in math/physics (but sciences in general)

Main training initiatives promoted by the Ministry of Education

- Initiatives managed by single schools for their own teachers
- Initiatives addressed to networks of schools
- Grants for masters or other university courses
- on-line national training plans
The **M@t.abel** program

The main ideas of this training program are:
- apply math to daily life problems, rather than abstract formulas
- base it on a mixture of formal lectures and on-line mentoring
- offer teachers a repository of classroom modules for math lessons
- last one entire school year
- promote a teacher community

It was started by the Ministry of Education in 2005. Given its growing popularity among schools, the ESF PON adopted **M@t.abel** and:
- *enriched* the training content in order to cover the whole curriculum
- *strengthened* the on-line learning platform
- *identified* schools to host the live/formal part of the training
- *commissioned* an evaluation of the impact of **M@t.abel** on students’ math performance
Why should **M@t.abel** work?

According to the literature on professional development for teachers [Garet et al 2001; Desimone et al 2002] M@t.abel seems promising. It is:

- content focused (four major content areas)
- extended in duration (whole school year)
- active learning processes
- implemented directly in the classroom
- based on peer collaboration between teachers

However, which features make professional development initiatives effective is still quite debated and even when designed according to the criteria suggested in the literature, the programs do not lead *per se* to effects on student achievement or on teacher instructional practices.
Does M@t.abel work?
To measure its effects, an RCT was set up

1. Teachers enrol through their school
2. To be eligible, the school must send at least 2 teachers
3. Schools are randomly assigned to treatment in the current year or to delayed treatment next year
4. Follow teachers and students three years

**ITT**: Intention to treat

- **ITT**: depends on the actual compliers

**ATT**: Average effect of the treatment on the treated

- **ATT**: depends on the complier self-selection
What effects do we measure and what data do we collect?

**Students:**
- math test scores standardized
- skipping items
- not completing the test

- attitudes toward math

  INVALSI national student assessment

  INVALSI student background questionnaire

**Teachers:**
- self reported practices and attitudes

  CATI interviews pre/post

- self reported classroom work during training

  training log books / diaries

<table>
<thead>
<tr>
<th>Year 2009-2010</th>
<th>Treatment group</th>
<th>Control group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schools</td>
<td>120</td>
<td>54</td>
</tr>
<tr>
<td>Teachers</td>
<td>409</td>
<td>172</td>
</tr>
<tr>
<td>Classes observed</td>
<td>401</td>
<td>172</td>
</tr>
<tr>
<td>Students observed</td>
<td>7.692</td>
<td>3.372</td>
</tr>
<tr>
<td>of which:</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6th grade</td>
<td>2.858</td>
<td>1.082</td>
</tr>
<tr>
<td>7th grade</td>
<td>2.314</td>
<td>1.113</td>
</tr>
<tr>
<td>8th grade</td>
<td>2.520</td>
<td>1.177</td>
</tr>
</tbody>
</table>
Only 39% of teachers actually completed the course ….

<table>
<thead>
<tr>
<th>TEACHERS</th>
<th>Treatment group (473)</th>
<th>Control group (193)</th>
</tr>
</thead>
<tbody>
<tr>
<td>«Lost» – no data available</td>
<td>79</td>
<td>27</td>
</tr>
<tr>
<td>Compliers</td>
<td>156</td>
<td>166</td>
</tr>
<tr>
<td>Non compliers</td>
<td>238</td>
<td>0</td>
</tr>
</tbody>
</table>

| STUDENTS | 7,692 | 3,372 |

Note: “Lost” = drop out due to uncontrollable factors (such as teachers deciding to retire or change of school at the beginning of the school year) and not related in any way to the experiment

Why quit?
- 34% before the start
- 14% did not implement the program properly
- 13% the training course actually never started in their area
- … too far, too much time, too difficult
How can the program be better targeted?

Features of non compliance have been explored using multivariate binary logistic models, pointing out to self-selection issues in the subsample of teachers actually completing the treatment / course.

Probability to be compliant is associated to:
- younger age, under 50 yrs old (odds of 50-55: -19 pt; over 55 – 25 pt)
- ICT familiarity (+12,5 pt)
- participation to previous in-service training opportunities (+19 pt)

We learned that:
- Enrollment through schools (although originality thought of as a sign of scarce motivation) is not necessarily a bad recruitment channel
- Non-tenured teachers should be admitted to the training as well as tenured teachers (younger age)
- All trainees should be PC/ICT literate (maybe the training could start be ensuring this…)
In the short term, no effects on students math achievement ... but an increase in the propensity of to skip at least one item ...

<table>
<thead>
<tr>
<th></th>
<th>Descriptive Statistics</th>
<th>Effect estimates and standard error (OLS and IV regression)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Treatment</td>
<td>Control</td>
</tr>
<tr>
<td>Math score (mean)</td>
<td>493</td>
<td>496</td>
</tr>
<tr>
<td>Skipping items (%)</td>
<td>65,8</td>
<td>59,9</td>
</tr>
<tr>
<td>Not completing the test (%)</td>
<td>6,8</td>
<td>5,4</td>
</tr>
</tbody>
</table>

Note: The symbols ***, **, * indicate that coefficients are statistically significant at the 1, 5, and 10 percent level. Math achievement scores are scaled (average of 500 and st.dev. 100 for 7th grade). OLS and IV regression models include control on stratification variables and the presence of an external observer during the national math assessment, correcting the standard error of the estimates with class clusterization.
“Treated” students appear to be more concerned about doing well in the test (and therefore avoid just guessing the answer). Several hints come from looking at the effects of M@t.abel on students’ attitudes:

- more **interested** in math
- stronger **self confidence** in math
- **less** frequently attributing academic **failure to chance** or to bad luck;
- … but they also are more **anxious** during the INVALSI assessment and say they have **not had enough time** on a given subject in the classroom

Although negative in the short-term, these effects on students’ attitudes could be promising for future improvements in math
Although there is no effect on average, middle-aged teachers show a significant positive impact on math scores…

<table>
<thead>
<tr>
<th>age group</th>
<th>ITT</th>
<th>ATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>over55</td>
<td>-8.2</td>
<td>-29.6</td>
</tr>
<tr>
<td>50-55</td>
<td>15.2 **</td>
<td>43.3 **</td>
</tr>
<tr>
<td>under50</td>
<td>-10.2</td>
<td>-18.4</td>
</tr>
</tbody>
</table>

Several clues that middle-aged teachers managed the new teaching approach better than the others. Respect to their treated peers, e.g.:

- these teachers declare less having problems with the classroom modules, more often they use digital support materials, less difficulties in general
- these students declare less to consider math more difficult for them than for their peers, less report learning difficulties due to the curriculum’s fast pace, less they feel they are nervous while taking the test

*(but fewer obs in subgroup make the estimation result more uncertain)*
Are teachers changing the way they teach?

<table>
<thead>
<tr>
<th>Item</th>
<th>Value controls</th>
<th>ITT</th>
<th>ATT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactions with colleagues</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Preparation of teaching materials jointly with colleagues, 1-3 times a week (Ref: less frequently)</td>
<td>47,2%</td>
<td>+12,3***</td>
<td>+31,5***</td>
</tr>
<tr>
<td>Exchange of point of views on how to teach a particular topic, 1-3 times a week (Ref: less frequently)</td>
<td>25%</td>
<td>+7,2*</td>
<td>+18,4*</td>
</tr>
<tr>
<td>Attitudes towards math teaching</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Many students show difficulties while doing logical abstract reasoning</td>
<td>7,04</td>
<td>-0,31***</td>
<td>-0,78***</td>
</tr>
<tr>
<td>Self-efficacy perception</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Make the students work together</td>
<td>7,45</td>
<td>-0,17**</td>
<td>-0,43**</td>
</tr>
</tbody>
</table>

In the school year following the treatment, treated teachers became significantly more eager to collaborate with peers at work, exchange with colleagues and more frequently based classroom activities on groups of students. They also used less the school textbook. And felt less confident about their effectiveness in promoting collaboration among students.

Teachers have been influenced by some features of the M@t.abel program: can these be promising for future effects on student achievement?
Further steps (on second and third year effects)

- Merging data at student individual level, obtaining a panel and assessing the [PON M@t.abel](#) effect on the increase in math achievement across school years
- Long term effects on teachers’ attitudes and practices
- Pooling data across cohorts to seek more robust «sub-group» effects

... data collection has been completed, estimations in course

<table>
<thead>
<tr>
<th>Year 1</th>
<th>Year 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treated</td>
<td>Controls</td>
</tr>
<tr>
<td>6th Grade</td>
<td>6th Grade</td>
</tr>
<tr>
<td>7th Grade</td>
<td>7th Grade</td>
</tr>
<tr>
<td>8th Grade</td>
<td>8th Grade</td>
</tr>
<tr>
<td>Treated (Y1&amp;2)</td>
<td>Treated Y2 (Former Controls)</td>
</tr>
</tbody>
</table>

...in Year 2 many (56%) of the former controls started [M@t.abel](#) (are treated)
Concluding remarks ...

Despite initial fears among institutions and researchers, it is possible to run a RCT evaluation (also!) in the Italian school system:

- many teachers were interested (contacts to web-site, etc.)
- almost all participated to pre-post treatment interviews (on 4% refusal first year, including controls)
- INVALSI regular datasets are rich and (despite fears for privacy requirements) it was possible to build a panel
- various institutions collaborated to make it possible (Ministry, INDIRE training platform, INVALSI)

Although there remains a considerable amount of work, we have learned form the evaluation and some re-adjustments to the logistics of M@t.abel are being made:

- RCTs must be designed ex-ante: this contributes to rationalization of the program itself and making the logic of intervention clearer
- more precise and homogeneous requirements on the training protocol
- some preliminary recommendations on how to target the program and to retain teachers
- tutors and experts setting up the teaching modules are more aware of the difficulties encountered by participants and try to improve
For more information on the RCT and results

M@T.abel evaluation website: http://www.invalsi.it/invalsi/ri/matabel/
(information on the design, communication to teachers and schools, results of surveys, etc.)

Gianluca Argentin et al. (2013), Preliminary Evidence from the M@t.abel Teacher Professional Development Program in Italy, WP INVALSI http://www.invalsi.it/download/wp/wp19.pdf


A. Caputo; A. Pennisi (2011), Insegnare la statistica a scuola: un confronto tra nuclei tematici nei diari di bordo del progetto M@t.abel 2009/10, Induzioni: demografia, probabilità, statistica a scuola, Anno 2011/42