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INTERNATIONAL CONFERENCE

DEVELOPING EDUCATIONAL POLICIES TO PROMOTE FORMATIVE ASSESSMENT: THE CONTRIBUTION OF EDUCATIONAL RESEARCH

Presentation:

Promoting formative assessment in mathematics: The impact of a teacher professional development program based on the dynamic approach

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Introduction

- The use of **assessment for formative purposes** is seen as a powerful means to achieve improved learning performance (Black, 2016; Hattie, 2009; Hopfenbeck & Stobart, 2015).

- Teachers who use **assessment** for **formative** rather than summative **purposes** were found to be **more effective** in promoting student learning outcomes (Creemers & Kyriakides, 2008; Hattie & Temperley, 2007).

- Teachers appear to **hold positive views** towards **assessment** that aids learning but their **practice** appears to be **outcome - oriented** (Earl & Katz, 2000; Kahn, 2000).

Introduction

- Teachers report **insufficient training in classroom assessment** both during their teacher preparation programs and their in-service professional development (DeLuca & Klinger, 2010).

- **Teacher Professional Development (TPD) programs** intended to improve **assessment practice** are **scarce** and have so far resulted in **mixed results** regarding their **impact** on **teacher skills** and on **student learning outcomes** (e.g. Randel, Apthorp, Beesley, Clark, & Wang, 2016; Schneider & Meyer, 2012; Schneider & Randel, 2010).

Introduction

- The **FORMAS project aims** to contribute in **improving professional standards** of **secondary teachers** by supporting them to conduct **assessment for formative reasons** and become **more effective** in terms of **promoting student learning outcomes (cognitive and meta-cognitive).**
- To achieve this purpose, the **project managed to:**

1. ***Develop a comprehensive framework for measuring teachers' assessment skills.***
   - By using this framework, professional standards in formative assessment were identified.
2. ***Establish valid instruments to measure teachers' professional needs.***
   - By using these instruments, a TPD course on assessment (based on the main assumptions of the Dynamic Approach-DA) was developed.
3. ***Evaluate the impact of the TPD course on improving teachers' assessment skills and on promoting student learning outcomes in mathematics (cognitive and meta-cognitive).***

Methods

Participants

- At the beginning of school year 2019-20, each country team (Belgium, Cyprus, Greece, and the Netherlands) invited **secondary school teachers who teach Mathematics in lower secondary schools** (i.e., Grades 7, 8 and 9) to participate in this study.
- Teachers who accepted to participate (n=206) were randomly split into two groups: **the experimental** (n=102) and the **control group** (n=104).
  - To avoid any spillover effect, randomisation was done at school level.
- Teachers of the experimental group were invited to participate in the TPD course on formative assessment.

Methods

Participants

- Student sample was consisted of **all students of two classes** of **each teacher** participating in the study.
- It was not possible to collect data at the end of the intervention from a relatively large number of teachers and students.
  - 166 out of 206 **teachers** participated in both measurement occasions.
  - 4012 out of 5447 **students** participated in both measurement occasions of students' **cognitive** skills in mathematics.
  - 3870 out of 5345 **students** participated in both measurement occasions of student **meta-cognitive** learning outcomes in Mathematics

Methods

Testing for selection bias

- **Inferential analysis** was conducted to test for any differences:
  - Between those (teachers and students) who **participated only in the first** measurement occasion and those who **participated** in **both** measurement occasions.
  - Between the **control** and the **experimental** group in terms of the **initial measures** of the **dependent** variables of this study and the **independent variables (i.e., background variables).**

Methods

The Intervention

Step 1: Initial evaluation

- The first step is concerned with the **identification of the professional development needs** of each teacher.
- A **teacher questionnaire** measuring **assessment skills** was administered at the **beginning of the intervention**.
  - The initial measurement helped us **classify teachers into three groups**.
- Student learning outcomes in mathematics (cognitive and meta-cognitive) were also measured by using written tests.

Methods

The Intervention

Step 2: Offering Training Sessions to Teachers of the Experimental Group

- Teacher educators provided to teachers of each group with **training material**, **opportunities for application of new knowledge** and **supporting literature** related to the assessment skills of their group, as well as with **clear instructions** about the area on which each group should concentrate for improvement.
- **Five 3-hour** (four face to face and one online due to the COVID_19 pandemic) training sessions were offered during the school year 2019-20.
  - This allowed teachers to **use the time-lapse** in-between sessions to **implement actions for improvement**, **get feedback** on their efforts and **adjust their action plans** accordingly.

Methods

The Intervention

Step 2: Offering Training Sessions to Teachers of the Experimental Group (continue)

- **The first session** of the TPD course was **common for all teachers** and in this session the initial measurement of teacher assessment skills was also carried out.
- **For sessions 2 to 5, teachers were grouped based on their professional needs** as these are identified by the initial measurement of their assessment skills.
- Given the decision to focus the study to secondary school teachers that taught Mathematics, the **content of the TPD course** (i.e., examples, application activities etc.) **was adjusted to address the subject of Mathematics**.

Methods

The Intervention

Step 3: Formative evaluation procedures during the TPD course

- Teacher educators worked closely with participating teachers to help them identify their **learning goals** and **choose actions** that can aid their achievement. They also provided **constructive feedback** during and through the sessions to support teachers' improvement efforts.

- Teachers of each group were asked to **reflect** on their **experiences** and **identify effective** or **non-effective practices**, share comments on the activities implemented and receive and provide constructive feedback.

Methods

The Intervention

Step 3: Formative evaluation procedures during the TPD course (continue)

- Teachers were asked to **complete application activities** related to their focus area.
  - The purpose of these application activities was to **provide teachers with opportunities to practice the skills under focus** as well as to **encourage collaboration** within the team.
- Teachers were encouraged to **collaborate** to **develop** appropriate **record templates** for given assessment activities that allowed the use of data for formative purposes.
- Teachers were also encouraged to **revise their action plans**, based on their own and others' experiences and on the material provided. This was done under the support and guidance of the research team.

Methods

The Intervention

Step 4: Final evaluation

- The final step of the TPD course **aims to identify its impact on the development of teachers' assessment skills** and its **indirect effect on student learning**.

- **Teachers' assessment skills** and **student learning outcomes** (cognitive and meta-cognitive) in Mathematics were **measured** by using the **same procedures and instruments** as in step 1 (see data collection section).

Methods

Data collection

Teacher Questionnaire

- A **questionnaire** was used to **measure teachers' skills in assessment**.
- A **validation study** of the teacher questionnaire took place in the **four participating countries in June 2019**.
- **Validation study:** Data from 574 teachers from the four countries were gathered and four within-country analyses were conducted by using the Extended Logistic Model of Rasch. Four items were considered as problematic and were removed. Empirical support to the construct validity of the questionnaire was provided.
- The **final version of the questionnaire was administered to all teachers** of the experimental and control group both at the **beginning and at the end** of the intervention.

Methods

Data collection

Teacher Questionnaire

- The **two separate Rasch** analyses of data from the two measurement occasions **generated further support** to the **construct validity** of the questionnaire.

- The **predictive validity** of the instrument was found to be **satisfactory** since data from the initial measurement (i.e., beginning of the intervention) per item were found to be highly correlated with those emerged from the final measurement (i.e., end of the intervention).

Methods

Data collection

Student learning outcomes in mathematics: **Cognitive outcomes**

- For each grade level, **criterion-reference tests** were constructed to measure students' knowledge and skills in mathematics in relation to the objectives of the national curriculum in the four participating countries.
- The written tests were **developed by a group of expert teachers and teaching mathematics academics** in each participating country.
- **Rasch analyses** provided **empirical support** to the **construct validity** of each test.
- The **ceiling and floor effects** in the attainment data **were not observed**.

Methods

Data collection

Student learning outcomes in mathematics: **Meta-cognitive outcomes**

- The **"Metacognitive Skills and Knowledge Assessment - MSA" tool** (Desoete, Roeyers, & Buysse, 2001) was adapted so as to measure student meta-cognitive skills in mathematics in the four participating countries. Its **face validity was also tested**.
- The MSA tool takes into account the **theoretical framework of Brown (1978)** and aims to measure two metacognitive components: ***1)*** *knowledge of cognition (i.e., declarative, conditional, procedural)* and ***2)*** *regulation of cognition (i.e., planning, monitoring, evaluation, information management skills)*.

Methods

Data collection

Student learning outcomes in mathematics: **Meta-cognitive outcomes**

Validation study

- We run **four different across-country analyses (per test)**, and was found out that the data that emerged from the validation study helped us **generate four scores**:
  - Knowledge of cognition
  - Regulation of cognition
    - Prediction
    - Planning
    - Evaluation
- Rasch analyses of data emerged from each measurement occasion provided further support to the **construct validity** of the MSA tool.
- The **predictive validity** of the scale measuring **procedural and declarative knowledge** was **not** found to be **satisfactory**.
- For **each measurement occasion**, only **three scores measuring** regulation of cognition (per student) were **generated**.

Main results

Main results

A. Impact on Teachers' Assessment Skills

Searching for selection bias: Teacher sample (across country analysis)

- **Experimental Vs Control group**:
  - The **t-test** did not reveal any statistically significant difference between the two groups in terms of their assessment skills at the beginning of the intervention and in terms of years of experience.
  - The **chi-square** test did not reveal any statistically significant difference between the experimental and control group in terms of teacher gender.
- **Teachers who participated in both measurement occasions** Vs **Teachers who participated only at the initial measurement:**
  - A statistically significant difference was identified by comparing the two groups in terms of their years of experience.
    - Teachers who did not participate in both measurement occasions had less years of experience (mean=13.3 SD=6.9) than teachers who participated in both measurement occasions (mean=16.1 SD=8.2).

Main results

A. Impact on Teachers' Assessment Skills

- At the end of the intervention, teachers of the experimental group were found to have better skills than those of the control group ($t=4.12$, $df=1.68$, $p<.001$).

- ***Regression equation: across-country analysis***

  - Post score = 0,028 + 0,865 * Prior Score + 0,397 * Group + residual

  - Standardised Beta for the intervention is 0,322

Main results

A. Impact on Teachers' Assessment Skills

- By considering the **stage** at which each **teacher** was found to be **situated**:
  - Mann Whitney did not reveal a statistically significant difference between the control and experimental group in terms of the stage that each teacher was found to be situated at the beginning of the intervention.
  - Statistically significant difference was found at the end of the intervention.
  - No progress was identified among the teachers of the control group.
  - Stepwise movement was observed among teachers of the experimental group.

Main results

B. Impact on Student Learning Outcomes

Searching for selection bias: student sample – across country analysis

Missing cases

- **T-test** reveal no statistically significant difference in cognitive prior achievement between students who did not participate in both measurement occasions and those who were considered in the final analysis.

- **Chi-square** test revealed no differences between those who participated and those who did not participate in both measurement occasions in terms of gender.

Main results

B. Impact on Student Learning Outcomes

Searching for selection bias: student sample – across country analysis

Experimental Vs Control group

- **Chi-square** test revealed a statistically significant difference between the control and experimental group (X^2=10.9 df=1 p=.001) in terms of gender. In the experimental group, the percentage of boys (47.2%) was higher than in the control group (42.8%).
- **T-test** reveal no statistically significant difference in prior cognitive achievement between students of the control and experimental group. (Within country analyses revealed differences in some countries but in favour of the control group.)
- Four separate multilevel analyses were conducted to identify the impact of the intervention on student cognitive outcomes and on each of the three measures of regulation of cognition.

Main results

B. Impact on Student Learning Outcomes: Cognitive Outcomes

Table 1. Parameter estimates and standard errors for the analysis of *Mathematics* achievement across countries (students within teachers)

Factors	**Model 0**	**Model 1**	**Model 2**
Fixed part			
Intercept	0.15 (.03)	-0.03 (.06)	-0.08 (.05)
Student level			
Prior achievement		0.59 (.02)	0.59 (.01)
Gender (0=boy, 1=girl)		0.13 (.03)	0.13 (.03)
Cyprus		0.19 (.07)	0.15 (.05)
Belgium		0.26 (.12)	0.23 (.11)
Greece		0.10 (.08)	-
DA (0=control, 1=experimental)			0.20 (.05)
Variance components			
Teacher	0.15 (.02)	0.07 (.01)	0.06 (.01)
Student	0.86 (.02)	0.61 (.01)	0.61 (.01)
Significance test			
X^2	11595.62	9523.30	9507.11
Reduction		2072.32	16.19
Degrees of freedom		4	1
p-value		.001	.001

Main results

B. Impact on Student Learning Outcomes: Meta-cognitive Outcomes

Table 2. Parameter estimates and standard errors for the analysis of *Prediction* across countries (students within teachers)

Factors	**Model 0**	**Model 1**	**Model 2**
Fixed part			
Intercept	0.11 (.03)	-0.00 (.05)	-0.06 (.04)
Student level			
Prior achievement		0.26 (.02)	0.26 (0.02)
Gender (0=boy, 1=girl)		0.13 (.03)	0.12 (.03)
Cyprus		0.10 (.06)	-
Belgium		0.29 (.14)	0.21 (.12)
Greece		0.03 (.07)	-
DA (0=control, 1=experimental)			0.23 (.05)
Variance components			
Teacher	0.07 (.01)	0.07 (.01)	0.06 (.01)
Student	0.85 (.02)	0.76 (.02)	0.76 (.02)
Significance test			
X^2	12040.63	10907.09	10885.40
Reduction		1133.54	21.69
Degrees of freedom*		3	1
p-value		.001	.001

Main results

B. Impact on Student Learning Outcomes: Meta-cognitive Outcomes

Table 3. Parameter estimates and standard errors for the analysis of *Planning* across countries (students within teachers)

Factors	**Model 0**	**Model 1**	**Model 2**
Fixed part			
Intercept	0.13 (.03)	0.09 (.05)	-0.01 (.03)
Student level			
Prior achievement		0.11 (.02)	0.12 (.02)
Gender (0=boy, 1=girl)		0.01 (.03)	-
Cyprus		0.08 (.06)	-
Belgium		0.10 (.13)	-
Greece		0.01 (.07)	-
DA (0=control, 1=experimental)			0.27 (.04)
Variance components			
Teacher	0.06 (.01)	0.06 (.01)	0.04 (.01)
Student	0.92 (.02)	0.91 (.02)	0.91 (.02)
Significance test			
X^2	12082.05	11494.12	11461.65
Reduction		587.93	32.47
Degrees of freedom		1	1
p-value		.001	.001

Main results

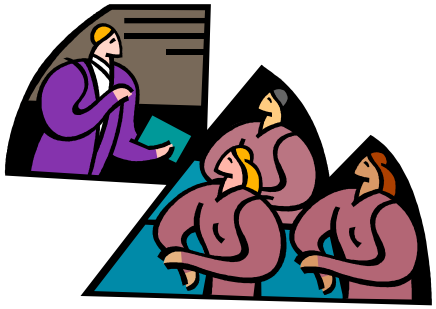
B. Impact on Student Learning Outcomes: Meta-cognitive Outcomes

Table 4. Parameter estimates and standard errors for the analysis of *Evaluation* across countries (students within teachers)

Factors	**Model 0**	**Model 1**	**Model 2**
Fixed part			
Intercept	0.13 (.02)	0.06 (.05)	-0.04 (.04)
Student level			
Prior achievement		0.26 (.02)	0.26 (.02)
Gender (0=boy, 1=girl)		0.03 (.02)	-
Cyprus		0.12 (.06)	0.12 (.04)
Belgium		0.23 (.13)	-
Greece		-0.01 (.07)	-
DA (0=control, 1=experimental)			0.26 (.04)
Variance components			
Teacher	0.05 (.01)	0.05 (.01)	0.03 (.01)
Student	0.90 (.02)	0.82 (.02)	0.82 (.02)
Significance test			
X^2	11418.07	10568.15	10534.79
Reduction		849.92	33.36
Degrees of freedom		2	1
p-value		.001	.001

Implications

- Evaluation data provided support to the use of the DA to TPD for promoting formative assessment in mathematics (and student learning outcomes).
- Implications for policy on TPD can be drawn.
- Implications for research investigating the sustainability of the intervention and exploring possibilities for scaling-up.



Thank you for your attention!

For more information on this project please contact the coordinator of the project **Prof. Leonidas Kyriakides**

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Main results

Effects (in Cohen's d values) of intervention on cognitive and meta-cognitive achievement of students were as follows:

- Teachers' assessment skill: 0.56

<u>Student learning outcomes in mathematics</u>

- Cognitive test: 0.24
- Regulation of cognition:
  - Prediction: 0.28
  - Planning: 0.30
  - Evaluation: 0.29