Domain: Teaching and Teacher Education
SIG 11 – Teaching and Teacher Education
SIG 18 – Educational Effectiveness

Quantitative Methods, Experimental Studies, Teacher Effectiveness, Mathematics, Secondary Education,

Teaching quality: An online intervention

Abstract: Several interventions have been designed and tested to modify the teaching quality; however, more research is needed to design scalable and replicable interventions. Therefore, in this research we have designed and tested the efficacy of an internet-based intervention to modify the teaching quality and students' motivation to learn and achievement. 667 middle school students and 26 math teachers took part in the study. Variables were assessed three times. Via a multilevel model we observed a significant Time X Group X Classroom interaction in teaching quality indicators, motivation to learn and grades. This research provides preliminary evidence of an online intervention to modify teaching quality, students' motivation to learn and grades.

Extended summary

Aims

How can we improve students' achievement? Within the school factors that affect students' learning, teaching quality is one of the most important. Students share a great deal of time with their teachers, and depending on the teaching quality, these hours spent together can be of great value, a waste of time or even detrimental for students. Several interventions have been designed and tested to modify the teaching quality, however more research is needed to design scalable and replicable interventions. Therefore, the aims of this study were to design and test the effectiveness of an online course to modify teaching quality in high-school math teachers, with the ultimate goal of improving students' math grades and motivation to learn.

Methodology

Participants

A total of 667 middle school students (49% males; mean age = 14.87 years, *SD* = 1.01), and 26 math teachers (34% males) participated in this study. Students were

drawn from 26 classes in Las Palmas de Gran Canaria, Spain, from grades 2 to 4 of secondary education, equivalent to year 9 to 11 in the U.K. system. The total sample comprised a similar number of students in each grade (Year 9, n = 139, M_{age} = 13.94; Year 10, n = 341, M_{age}=14.75; Grade 11, n = 187, M_{age} = 15.76). The schools comprised a mix of urban and outlying rural schools whose students were predominantly from middle class families.

Measures

Teaching quality. We used the 53-item scale. The scale assesses nine factors: A) *Teaching for relevance*: the teacher uses useful and interesting class contents and activities. B) *Acknowledge negative feelings*: The teacher understands negative emotions arisen in class. C) *Participation encouragement*: The teacher pushes students to take part in class, by asking questions or soliciting students' opinions. D) *Non-controlling language*: The teacher do not talk to student in rigid and directive language. E) *Optimal challenge*: The teacher takes into account student level when assigning activities. F) *Focus on the process*: The teacher stresses the importance of classwork and learning over marks. G) *Classes structure*: The teacher prepares and structures the classes and activities well. H) *Positive feedback*: The feedback provided is quick, positive, and specific. I) *Caring*: The teacher looks after and pays attention to students. Reliability ranged from ω=.811 (Focus on the process at T1) to ω=.933 (Positive Feedback at T3).

Motivation to learn. We used a subscale of the Spanish validation of the Échelle de Motivation en Éducation. Because our aim was to assess the pleasure experienced while learning new content in mathematics, we used the four items of the Intrinsic Motivation toward knowledge subscale (e.g. "Because for me it is a pleasure and satisfaction to learn new things") and presented with the stem "Why are you trying to do

things well in math?" The scale showed evidence of reliability (ω=.905, ω=.907, and ω =.898).

Math grades. To assess students' math performance, we obtained students final course grades in mathematics, coded to 1 (lowest mark) to 10 (highest mark). Unlike in the United States or United Kingdom, where it is usual to assess student's achievement by standardized test, in Spain we use grades assigned by teachers according to rubrics implemented by the Government to assess the knowledge, skills and daily work of the students. These grades have a real-world meaningful on students' academic level and progress in grade school, they even affect the degrees or universities students can choose.

Procedure

First of all, we contacted by telephone with the math department of different high schools, and set up an appointment and explain the research if interested. Finally, 33 teachers from 14 high schools decided to take part in the study. Next, we randomly assigned the teachers to the experimental or control arm, instead of individually assigning them to one or other group, the whole high school was the unit of assignment. 18 teachers from 8 high schools were assigned to the intervention arm and 16 from 6 high schools to the control arm, unfortunately one high school decided not to take part just before the beginning of the data collection.

Data collection for teaching quality and motivation to learn started in October, four weeks after the academic course started, to give students enough time to be able to know their teacher. Math grades were handed by teachers at the end of each trimester, December, March and June.

Data analysis

We began by computing mean and standard deviations for major variables (teaching quality, motivation to learn and math grades) for the experimental and control group in the three evaluations. Next, we ran a three level (waves, subjects and classroom) multilevel longitudinal test to analyze the efficacy of the intervention; specifically we expected an interaction between both groups X Time X Classroom. Lastly, to compute effect size, we estimated Pseudo R square.

Main results

In table 1 mean and standard deviation of major variables across the three time points can be seen.

Table 1

Mean and standard deviation across the three times

	Control		Experimental	
	Mean	*SD*	Mean	*SD*
Teaching for relevance T1	4.314	1.340	4.374	1.593
Teaching for relevance T2	4.235	1.435	4.339	1.647
Teaching for relevance T3	4.044	1.550	4.262	1.620
Acknowledge negative feelings T1	3.724	1.508	3.670	1.736
Acknowledge negative feelings T2	3.686	1.535	3.648	1.705
Acknowledge negative feelings T3	3.550	1.612	3.800	1.749
Participation encouragement T1	4.838	1.422	4.796	1.573
Participation encouragement T2	4.708	1.480	4.849	1.562
Participation encouragement T3	4.343	1.581	4.784	1.627
Non controlling language T1	2.519	1.461	2.296	1.422
Non controlling language T2	2.563	1.437	2.312	1.381
Non controlling language T3	3.130	1.599	2.461	1.457
Optimal challenge T1	4.581	1.500	4.342	1.733
Optimal challenge T2	4.502	1.507	4.317	1.757
Optimal challenge T3	4.284	1.689	4.225	1.800
Focus on the process T1	4.937	1.579	4.688	1.720
Focus on the process T2	4.825	1.641	4.672	1.777
Focus on the process T3	4.377	1.623	4.690	1.814
Classes structure T1	5.444	1.444	5.350	1.672
Classes structure T2	5.268	1.604	5.288	1.752
Classes structure T3	5.005	1.559	5.218	1.730
Positive feedback T1	5.073	1.331	4.687	1.683
Positive feedback T2	4.914	1.492	4.720	1.710
Positive feedback T3	4.514	1.617	4.715	1.711

Caring T1	4.173	1.539	4.127	1.714
Caring T2	4.110	1.581	4.157	1.716
Caring T3	3.928	1.622	4.278	1.766
Motivation to learn T1	4.553	1.512	4.348	1.616
Motivation to learn T2	4.503	1.490	4.308	1.636
Motivation to learn T3	4.048	1.662	4.103	1.725
Grades T1	4.970	1.744	5.280	2.118
Grades T2	5.210	2.062	5.240	2.168
Grades T3	5.180	1.989	5.560	2.258

With regard to the multilevel test, we observed a significant Time X Group X Classroom interaction in all variables except for Teaching for relevance, Optimal challenge and Grades (see Table 2). Further analysis with grades testing a curvilinear trajectory display a significant result. Overall, these results showed evidence of the efficacy of the intervention.

Table 2

Results from the multilevel test: Interaction term

	β	SE	*p*	Confidence interval	
Teaching for relevance	-.103	.059	.082	-.219	.013
Acknowledge negative feelings	-.144	.068	.036	-.278	-.009
Participation encouragement	-.253	.064	.000	-.379	-.126
Non controlling language	.239	.071	.001	.100	.378
Optimal challenge	-.126	.070	.074	-.265	.012
Focus on the process	-.273	.073	.000	-.416	-.131
Positive feedback	-.316	.065	.000	-.443	-.190
Caring	-.222	.065	.001	-.349	-.095
Motivation to learn	-.139	.067	.039	-.270	-.007
Grades	-.054	.016	.001	-.086	-.022

Significance of the research

This research provides preliminary evidence of the efficacy of an online intervention to modify teaching quality for students' motivation and grades. Thus, the teacher that understands negative emotions arisen in class; pushes students to take part in class, by asking questions or soliciting students' opinions; do not talk to student in

rigid and directive language; stresses the importance of classwork and learning over marks; prepares and structures the classes and activities well; provides quick, positive, and specific feedback, and looks after and pays attention to students, will improve the students' motivation to learn and math grades over time. This finding could be considered in future intervention programs to improve the teaching-learning process in the math class.