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Improving quality and equity in schools in socially disadvantaged areas

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ABSTRACT

Background: Recent effectiveness studies have investigated the relationship between two dimensions of effectiveness – namely, quality and equity. Specifically, the question of whether effective schools can also reduce the initial differences in student outcomes attributed to student background factors has been examined. In this context, the Dynamic Approach to School Improvement (DASI) makes use of theory and the research findings of effectiveness studies to try to improve school effectiveness in terms of quality and equity.

Purpose: This study aimed to examine whether the implementation of DASI in primary schools in socially disadvantaged areas in four European countries (Cyprus, England, Greece and Ireland) was able to promote student learning outcomes in mathematics and to reduce the impact of student background factors on student achievement in mathematics.

Design and methods: A sample of 72 primary schools across the four countries was randomly split into experimental and control groups. At the beginning and at the end of the school year, mathematics tests were administered to all students of Grades 4–6 (n = 5560; student ages 9–12 years). The experimental group made use of DASI. Within-country multilevel regression analyses were conducted to evaluate the impact of the intervention and search for interaction effects between the use of DASI and student background factors on final achievement.

Results: In each country, the experimental group achieved better results in mathematics than the control group. At the beginning of the intervention, the achievement gap based on socio-economic status (SES) was equally large in the experimental and the control groups. Only in the experimental group did the achievement gap based on SES become smaller. However, DASI was not found to have an effect on equity when the equity dimension was examined by focusing on the achievement gap based on either gender or ethnicity.

Conclusions: Implications of findings are drawn and the importance of measuring equity in terms of student achievement gaps based on different background factors, rather than only on SES, is emphasised. We propose the evaluation of the impact of interventions on promoting equity by the use of various criteria.

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Introduction

Education and schooling have, historically, aimed at supporting students to improve their skills and knowledge in different domains of learning and in subjects based on a series of criteria set by educational systems (Creemers and Kyriakides 2008). The contribution of educational systems, schools and individual teachers to the progress of students with respect to different learning outcomes has been studied extensively through research within the field of educational effectiveness. In fact, during the last 30 years, Educational Effectiveness Research (EER) has placed almost exclusive emphasis on the search for factors that may affect student learning progress and academic outcomes (i.e. *the quality dimension of effectiveness*). However, research has also shown that student outcomes may be affected, too, by factors deriving from their background, such as their family's socio-economic status (SES), ethnicity and gender – in other words, factors which are not likely to change (Schmidt et al. 2015). This consistent finding has led researchers within the field of EER to propose the use of two dimensions of effectiveness, namely, *quality* and *equity* (Kelly 2012; Kyriakides, Creemers, and Charalambous 2018a). In addition, recent effectiveness studies aim to determine whether effective schools can reduce the initial differences observed in student outcomes which can be attributed to student background factors that are unlikely to change (e.g. Charalambous, Kyriakides, and Creemers 2018; Kyriakides, Creemers, and Charalambous 2018b).

Given the rapid changes in the composition of student populations in many educational systems, mostly deriving from changes in social and economic conditions around the world and the constant flow of students coming from disadvantaged and migrant backgrounds, the importance of examining the effectiveness of schools in terms of their ability to promote not only quality, but also equity, is ever more evident (Blömeke, Suhl, and Kaiser 2011). Different ways of conceptualising and measuring equity exist within the research paradigm, based on different philosophical assumptions about the role that the school has to fulfil regarding the reduction of differences in student learning outcomes (Atkinson 2015; Espinoza 2007). The dominant approaches to equity are based on either the meritocratic (Shepelak and Alwin 1986; Slomczynski and Wesolowski 2001) or the egalitarian perspective (Kyriakides, Creemers, and Charalambous 2018a; Van Damme and Bellens 2017).

The meritocratic perspective is grounded on the assumption that a positive relation exists between one's merits, talents, and effort to succeed and their desired outcomes: either financial, academic, prestige in society or any other (Gulson and Webb 2012; Kunovich and Slomczynski 2007; McCoy and Major 2007). Supporters of this view assume that the differences identified between students in terms of their learning outcomes can be explained by examining their cognitive abilities, talents and the effort made to succeed. One could argue that this assumption is partly supported by findings of EER, which reveal the importance of treating aptitude, prior achievement and perseverance as student-level factors that can explain variation in student learning outcomes. However, EER has also shown that students demonstrating the same talents, skills and effort to succeed do not always manage to develop in similar ways and reach the same goals to the same degree (Kyriakides, Creemers, and Charalambous 2018a; Sammons, Toth, and Sylva 2018). Research findings in educational effectiveness do not only reveal

that effectiveness factors operate at different levels (and not just at student level). They also show that student background factors that are unlikely to change – such as SES, ethnicity and gender – can also explain variation in student learning outcomes (Kyriakides, Creemers, and Charalambous 2018b; Scheerens 2016). It is important to note that, although the effort made by students to succeed has not been systematically examined (due to difficulties in measuring this construct), there are studies claiming that the effort to succeed may be affected by a series of different background factors, such as high SES, favourable home learning environment and family expectations (Hartas 2011; Melhuish et al. 2008; Sammons, Toth, and Sylva 2018; Sylva et al. 2013; Rattani and Shah 2011). This implies that even in cases where students are provided with the same learning opportunities at school, the learning opportunities they receive at home may differ to a large extent due to a variety of reasons, such as parents' education, financial and work status, ethnicity and/or first language (Lim 2013; Moss et al. 2008), which may ultimately lead to variations in student learning outcomes (Kyriakides, Creemers, and Charalambous 2018a; Scheerens 2014).

The egalitarian perspective takes into consideration the mechanisms outside the school that may affect the actual learning opportunities given to students and, therefore, their academic outcomes. This viewpoint suggests that in order to better address issues of equity, attempts should be made in order that differences in student background factors are not reflected in their learning outcomes (Van Damme and Bellens 2017). This, however, implies that the 'one–size-fits-all' approach is not effective in addressing issues of equity in education. Instead of providing the same learning opportunities to all students, it is argued that schools should provide increased learning opportunities to students who do not come from favourable backgrounds, so as to compensate for the original injustices these students may face (Charalambous, Kyriakides, and Creemers 2018; Kelly and Downey 2010). Accordingly, this type of positive discrimination is not only considered by some as acceptable, but, in fact, essential to promote equity actively in schools, especially against the backdrop of international research evidence identifying relationships between student performance and socio-economic status. The results of international comparative studies such as the Programme for International Student Assessment have drawn attention to differences between the performance of students from disadvantaged backgrounds compared with those from more advantaged backgrounds (see Schleicher 2014).

It follows, we argue, that schools comprised of students coming from disadvantaged backgrounds should treat issues of equity as a priority and aim to be involved in specialised school-based interventions to address both issues of quality and equity (Charalambous, Kyriakides, and Creemers 2018; Kelly 2012; Scheerens 2016). In particular, the extent to which an intervention is able to help students improve their learning outcomes (*quality*) and also manage to 'reduce' the impact of different background factors on student learning outcomes (*equity*) should be investigated. In this paper, we argue for the importance of whole school interventions that make use of the available knowledge base of research on educational effectiveness in order to promote both quality and equity in education. We also claim that evaluation of such interventions should not only use value-added approaches to investigate the impact of the intervention on student achievement gains (quality dimension), but also search for their impact on promoting equity. In regard to the evaluation of the impact

of an intervention on promoting equity, we support the idea that it is important to consider the impact of student background factors that are unlikely to change on student learning outcomes. At this point, it should be acknowledged that equity in education could also be examined in two ways that are closely linked and can help us analyse the implications of school failure for teachers/schools/systems: equity as *fairness* and equity as *inclusion*. Specifically, school failure can be seen to be twofold in nature. On the one hand, it could be viewed as the failure of an educational system which is unable to provide an education of quality for all. In this case, overcoming school failure implies ensuring inclusion by providing a basic minimum standard of education for each and every student. The inclusion perspective has implications for designing effective national reform policies that minimise dropout rates and provide learning opportunities for all children. Secondly, school failure can be attributed to the fairness perspective, which is based on the fact that factors beyond those that students can control are associated with student learning outcomes (Kyriakides, Creemers, and Charalambous 2018a). This paper is focused on *equity as fairness*, which implies that personal and social circumstances should not be obstacles to educational learning outcomes. It is for this reason that we propose the evaluation of an intervention promoting equity by considering whether the impact of background factors such as SES, gender and ethnicity is smaller in the schools which made use of the intervention compared with the control group.

Research aims

In this context, this paper aims to examine whether a school-based intervention that was implemented to support primary schools in socially disadvantaged areas in four European countries (Cyprus, England, Greece and Ireland) was able to promote not only quality but also equity. The whole school intervention presented in this paper was based on the *Dynamic Approach to School Improvement (DASI)* (Creemers and Kyriakides 2012), which involved the identification of each school's individual improvement priorities, and the design and implementation of whole school improvement strategies and action plans to promote quality in education that take into account the knowledge base of EER. The effect of DASI on promoting quality has been demonstrated through several previous national and international experimental studies (see Creemers and Kyriakides 2015). However, the impact of DASI on promoting equity has not been systematically examined. In this paper, we propose the use of a methodology based on a design which allows the impact of an intervention to be examined in terms of promoting both quality and equity. Further, we demonstrate how this methodology can be used in practice. Specifically, we investigate the impact of this DASI-based intervention on promoting not only quality (in terms of improving student learning outcomes) but also equity (in terms of reducing the impact of SES, ethnicity and gender on student achievement). In the next section, a brief presentation of the rationale and main elements of DASI is presented. This sets out the reasons why DASI is expected to have an effect on promoting both quality and equity in education. We then present the methods and main findings of our attempt to evaluate the impact of this project on promoting quality and equity in each of the four participating countries (i.e. Cyprus, England, Greece and Ireland).

Overview of DASI

One of the main criticisms that school improvement initiatives have received during the past years is that they lack a theoretical foundation upon which the production of positive educational results can be based (Buczynski and Hansen 2010; Domitrovich et al. 2009). Even though research in the field of educational effectiveness has progressed to a large extent during the last three decades and evolved methodologically (Goldstein 2003; Creemers, Kyriakides, and Sammons 2010), as well as theoretically (Levine and Lezotte 1990; Scheerens and Bosker 1997; Creemers and Kyriakides 2008; Scheerens 2013), sufficient links between EER and school improvement have not yet been established (Kyriakides, Creemers, and Charalambous 2018a). A relationship between theory and practice in education in general and in educational effectiveness and school improvement specifically, has not always been achieved (Townsend 2007).

Thus, bearing in mind the need for whole school interventions that are theory-driven, DASI was developed and comprises an approach to school improvement which is based on one of the most recent theoretical models in the field of educational effectiveness which received empirical support (Bates 2010; Sammons 2009; Scheerens 2013), namely, the *dynamic model of educational effectiveness* (for more information see Creemers and Kyriakides 2008). The dynamic model refers explicitly to two dimensions of effectiveness – *quality* and *equity* – and is multilevel in nature, since it supports the importance of specific factors operating at different levels (i.e. student, classroom, school and system) that need to be addressed to promote quality and equity in education. Thus, using the main assumptions of the dynamic model as a starting point, DASI considers that school improvement efforts should include actions for improving school factors that were found, through research evidence, to be associated with student achievement gains (e.g. Hattie 2009; Kyriakides et al. 2010, 2015; Scheerens et al. 2005; Lüftenegger et al. 2012; Mainhard, Brekelmans, and Wubbels 2011). Specifically, since the ultimate goal of schools is to assist students to develop their knowledge, skills, attitudes and, more generally, maximise their learning gains (either cognitive or non-cognitive) (Walberg 2007), DASI draws attention to the importance of improving the functioning of two overarching school factors included in the dynamic model that were found, through research, to be associated with improvements in student outcomes: *school policy and actions taken to improve*: (a) *teaching* and (b) *the school learning environment (SLE)* (Hattie 2009; Kyriakides et al. 2010).

In regard to the school factor concerned with teaching, the dynamic model includes aspects of school policy for teaching associated with (a) quantity of teaching, (b) provision of sufficient learning opportunities and (c) quality of teaching. Actions taken for improving the three aspects of teaching practice above, such as the provision of support to teachers for improving their teaching skills, are also taken into account. In regard to the factor concerned with the SLE, the dynamic model investigates school policy on the following four aspects which define the environment of the school:

(1) student behaviour outside the classroom,
(2) collaboration and interaction between teachers,
(3) partnership policy (i.e. the school's relations with the community, the parents and the advisors) and
(4) provision of sufficient learning resources to students and teachers.

The first three aspects refer to the rules which the school has developed for establishing a learning environment inside and outside the classroom. However, the idea that learning is not restricted to student learning, but also to actions for promoting the learning of other stakeholders, such as teachers and parents, is taken into account. For this reason, collaboration and interaction between teachers is included too under this overarching factor. This is because it may, on the one hand, contribute to teachers' professional development and, on the other hand, affect teaching practice, thus contributing to student learning (Goddard, Goddard, and Tschannen-Moran 2007). Similarly, by involving parents in the functioning of schools and assisting them to support the learning of their children at home, the school facilitates student learning through both the classroom learning environment (e.g. when parents provide teachers with information regarding their children or bring human and other resources to the school) and the home learning environment (e.g. when parents are informed on how to support/supervise their children when doing their homework) (Fan and Chen 2001; Hartas 2011, 2012; Melhuish et al. 2008; Ngorosho 2011). Additionally, the school's policy on providing resources for learning is included under the factor referring to the SLE. Having sufficient and appropriate learning resources in schools may both affect student learning and encourage the learning and professional development of teachers. For example, schools can develop a policy for the use of visual material and technological equipment in teaching. In this context, the school management team may encourage teachers to learn from each other about how to use the available resources in an effective way. The availability of resources, such as specific software for teaching mathematics, may not, by itself, promote teacher professional development unless the school management team offers professional development opportunities to teachers about the use of the resources. A plan should also be designed for the fair allocation of the resources between the teachers (and, in some cases, among students of different age groups).

Taking into consideration the fact that not all schools are equally effective, DASI assumes that different improvement strategies should be used for each individual school, in order to help it improve its effectiveness. Therefore, when using DASI, schools are supported by an *Advisory and Research Team* (hereafter the A&R Team) to identify the current situation regarding their school policy for teaching and the SLE and design focused strategies, through an action plan to improve different aspects of the functioning of these two overarching factors. At each stage of the intervention, regular meetings (for at least two hours) of the school management team with the A&R Team are organised once every six weeks in order to ensure that DASI is effectively implemented in each school. In this context, school stakeholders (i.e. teachers, students and parents) and the A&R Team are expected to be actively involved in each step of DASI. Their ability to work together and exchange skills, expertise and experience is critical to the success of any school improvement project based on DASI. It is important to note that although each school is treated as a professional community responsible for designing and implementing its own improvement strategies and action plans, school stakeholders are not left alone to design and implement their strategies and actions. Rather, school stakeholders are encouraged to make use of the A&R Team and any other available resource within and/or outside of the school. Therefore, a systematic research-based approach to design, implement and evaluate improvement efforts (Brown, Schildkamp, and Hubers 2017; Bryk et al. 2010; Rowan et al. 2009) is promoted by DASI (see Creemers

and Kyriakides 2012). This is reflected in its assumption that both school stakeholders and the A&R Team should develop and implement their own school improvement strategies and action plans and, in its recognition that each school may have different improvement needs. Thereby, data measuring the functioning of school factors need to be collected in order to help school stakeholders and the A&R Team identify their own improvement priorities.

For a full depiction of the steps of DASI, see Creemers and Kyriakides (2012). For the purposes of this overview, we summarise and describe the major steps A–F. DASI recognises the importance of establishing consensus among school stakeholders about the general purpose and the aims of any school improvement project. Thus, before schools are able to design and implement their action plans, consensus should be reached among a school's stakeholders regarding the ultimate aim of the efforts made to improve specific aspects of their school's functioning. This constitutes Step A: *establishing clarity and consensus about the general aim of school improvement: promoting student learning*. Without reaching consensus and developing the realisation that the ultimate goal of the intervention is to improve the quality of education offered to students and promote equity, it is unlikely that the stakeholders will be sufficiently actively involved to implement the action plans that will be developed. During this step, it is therefore expected that the A&R Team will encourage school stakeholders to discuss the importance of promoting not only quality but also equity. In the next step, B, it is proposed that the school stakeholders discuss the importance of dealing with the specific school factors which were found, through research, to be related to student learning outcomes, and identify how – and under which conditions – quality and equity can be promoted by improving the functioning of these factors. Hence, step B comprises *establishing clarity and consensus about the aims of school improvement: addressing school factors associated with learning*. Since the functioning of specific school factors should be evaluated, the school, in collaboration with the A&R Team, is then expected to develop evaluation mechanisms in order to collect and analyse data about the functioning of school factors and identify those that perform less well, so as to define their priority area(s) for improvement. Step C is, therefore, *conducting the school self-evaluation (SSE)*, by way of *collecting evaluation data, analysing evaluation data and identifying priorities for improvement*.

In terms of time, approximately four weeks are provided for schools to design and implement their action plans and identify effective and ineffective actions. During this time, the A&R Team provides schools with guidance and relevant material (e.g. a handbook with examples of actions for improving each factor). Step D is thus summarised as *designing improvement strategies and action plans by considering the knowledge base relating to the factors addressed*. Then, as schools are dynamic organisations with ongoing processes, the action plans are adapted to meet the schools' continuous needs, with the guidance of the research team through a formative evaluation process (i.e. step E: *monitoring the implementation: formative evaluation*). One of the main assumptions of the theoretical model upon which DASI is based is that merely by designing and implementing school interventions one cannot ensure their impact. Therefore, interventions based on DASI are also evaluated at the end of the intervention for summative purposes, in order to examine the impact of the school improvement intervention on promoting student learning outcomes (i.e. cognitive, affective, psychomotor, meta-cognitive) and

reducing the impact of different student background factors on student achievement (step F: *measuring the impact of DASI: summative evaluation*). It is for this reason that, in this paper, we explore the impact of a European school improvement project based on DASI and promoting not only *quality*, but also *equity*.

Methods

Ethical considerations

All necessary authorisations and permissions to conduct the study were granted by the countries' corresponding authorities, which varied according to the structure of the educational system of each participating country. In each country, informed consent was granted by the parents of the students who participated in the study. In addition, all data were gathered anonymously (both from students and teachers). Anonymity was also applied at school level, since neither the names of the participating schools nor their region were made known to the public. Consequently, all data were entered in the data bank of the project by using specific student, teacher and school codes.

Participants

This study took place in four European countries: Cyprus, England, Greece and Ireland. It is important to note that the four European countries were chosen due to the fact that the promotion of equity is considered a priority in each one of these countries (see OECD 2010, 2012). It should also be noted that the dynamic model of educational effectiveness (see Creemers and Kyriakides 2008), which is the theoretical framework upon which the intervention of the present study is based, has been empirically tested in these four countries through several international and national studies (e.g. Kyriakides et al. 2015; Panayiotou, Kyriakides, and Creemers 2016; Panayiotou et al. 2014; Christoforidou and Xirafidou 2014). In addition, there is variation between these four countries regarding the way that educational policy is applied to schools in order to support students coming from low socio-economic backgrounds. Therefore, this study aimed to raise awareness among policy-makers and practitioners in these four countries and help them identify school factors that can promote quality and equity in education.

In each country, primary schools in socially disadvantaged areas (i.e. schools with more than 40% of their students coming from lower SES backgrounds) were invited to participate in this study. The country's research team explained the aims and methods of the study to each head teacher. It was made explicit to the head teachers that the team's role was to support schools to develop and implement their own improvement strategies and action plans, addressing factors operating at the school level. It was also made clear that the main goal of the intervention was to promote the learning of all students . As the intervention is mainly concerned with the role of the head teacher and the school management team, the decision was taken to ensure that none of them was aware, in advance, of the hypotheses of the study and the rationale and main assumptions of DASI. It was also expected that they would not work with a specific group of students only. Rather, the expectation was that they would further develop the policies of their schools by helping the various school stakeholders (i.e. teachers, parents,

students, non-teaching staff) understand what their role was meant to be and by supporting each group of school stakeholders to implement their improvement strategies and action plans effectively.

In total, 72 schools agreed to participate in this study. The school sample was randomly split into an experimental group and a control group. The research team in each country had conducted a pre-measure of achievement, in mathematics, of all Grade 4, 5 and 6 students (n = 5560) in the participating schools, and of the functioning of the school-level factors. In terms of pupil ages, when referring to Grade 4 students we mean students of 9–10 years; when referring to Grade 5 students we mean students of 10–11 years; and, when referring to Grade 6 students, we mean students of 11–12 years. The research teams asked both groups of schools to develop and implement improvement strategies and action plans to improve their effectiveness. At the end of the school year, student learning outcomes in mathematics and the functioning of school factors were measured.

Support offered to the experimental group

At the beginning of the school year 2015–2016, an external seminar to schools participating in the experimental group was organised to discuss the aims of the project and its main phases with the school stakeholders (i.e. steps A and B of DASI). The research team had also produced a handbook in which the theoretical framework and the main steps of the intervention were briefly explained. Suggestions for schools were provided about how to develop school evaluation mechanisms (see the web page of the project, www.ucy.ac.cy/promqe). At this point, the research team for each country supported each school to establish school evaluation mechanisms (i.e. step C of DASI). By means of analysing the data that emerged from each school, those school factors measuring policy for teaching and the SLE which were found to perform less well were identified. For example, some schools had to develop strategies and action plans in order to ensure the maximisation of teaching time, whereas other schools had to develop strategies and action plans to improve the school partnership policy. It is worth mentioning that a significant number of schools in the experimental group from each country had designed action plans to improve their policy on the quality of teaching. Since the dynamic model refers to eight specific teacher factors found to be associated with student achievement (i.e. orientation, structuring, questioning, teaching-modelling, applications, time management, teacher's role in making classroom a learning environment and classroom assessment), each school's management team organised staff meetings to define the characteristics of effective teaching (by making use of the available knowledge-base of teacher effectiveness research). Support was then provided to teachers to help them to improve their teaching skills accordingly. For example, in some schools, the teachers had difficulties in handling misbehaviour and disorder in an effective way. For this reason, it was decided that teacher professional development seminars would be organised to help teachers develop their skills in creating a supportive environment for learning in their classroom and to manage misbehaviour in an effective way.

Schools were encouraged to establish a committee with representatives of parents, students and teachers to discuss the results of school evaluation and to gradually reach a consensus about the improvement priorities of their school. The final decision was announced to the whole school community and feedback was provided, which helped

schools to produce a clear definition of their improvement area(s). At the next stage, school stakeholders (in co-operation with the research team) developed their improvement strategies and action plans (i.e. step D of DASI). Moreover, school stakeholders were asked to take actions in order to monitor the implementation of their strategies and action plans (i.e. step E of DASI). At this stage, the intervention based on DASI was carried out for almost eight months and the research team supported the school stakeholders to address any possible difficulties that emerged during the implementation of their action plans. Each country research team visited the schools in the experimental group at least once every six weeks, to offer feedback and support in the implementation and/or in redesigning their action plans. During these visits, the research team had a meeting lasting at least two hours with the school management team to discuss the implementation of the action plans and take decisions on how to develop their action plans further. In addition, an intra- and inter-country network of schools addressing the same factors was established in order to exchange experiences and practices during the intervention period.

Support offered to the control group

According to the results that emerged from a pre-measure concerned with student achievement in mathematics and the functioning of the school factors (as evidenced by teacher responses to the questionnaire measuring the school factors of the dynamic model), the research teams gave feedback to the control group of primary schools (n = 36), but without mentioning what their improvement priorities were. These schools were offered support to develop their own strategies and action plans in order to improve their effectiveness, but without making use of DASI. As a consequence, each school decided to develop strategies and action plans to improve different school factors but only some of the schools were concerned with the improvement of factors included in the dynamic model (but without the knowledge that these factors are included in the model and without having access to the relevant literature and the handbook of the project). By following this approach, we were able to provide equal support to each group and at the same time to control for the Hawthorne effect in two ways: both groups put the same amount of effort in their specific treatment and schools of each group were not aware of the other treatments, thus avoiding compensatory rivalry or resentful demoralisation by any of the group (Shadish, Cook, and Campbell 2002). It is, finally, important to note that all schools of both the experimental and control groups managed to continue with the project for the whole school year and the great majority of them asked the research team to support them in implementing their improvement strategies and action plans in the following school year. Thus, this group of schools was treated as a control group, and data on student achievement and on the functioning of school factors were collected both at the beginning and at the end of the intervention from both groups, in order to evaluate the impact of DASI on promoting quality and equity.

Improvement effort

Since one of the main threats to the internal validity of experimental studies has to do with the extent to which all the groups put the same amount of effort into implementing an

intervention, different sources of data were used to measure the extent to which each school had put effort into implementing their action plans. Specifically, we conducted content analysis of the reflective diaries that each school coordinator kept, in order to identify each school's effort into the improvement project. Moreover, the constant comparative method was used to analyse data that emerged from interviews with the head teachers, school coordinators and teachers in each school. These interviews were concerned with the experiences and attitudes of school stakeholders towards the implementation of the intervention that took place in their schools (see Antoniou and Griaznova 2018). The analysis of the qualitative data helped us generate ordinal data measuring the extent to which each school in the experimental and control groups invested efforts into implementing their improvement strategies and action plans. The Kolmogorov–Smirnov two-sample test did not reveal any statistically significant difference between the members of the two groups, in terms of the amount of effort they put into implementing the intervention (K-S $Z = 0.81$, $p = 0.51$).

Measures

Student achievement in mathematics at the beginning and at the end of the intervention

For each year group of students, curriculum-based tests in mathematics were constructed in order to measure their knowledge and skills in mathematics. Mathematics was chosen because educational effectiveness studies reveal that the school effect in promoting cognitive learning outcomes in mathematics is greater than for any other subject (see Chapman et al. 2016; Kyriakides et al. 2010; Scheerens 2013). In addition, practicality issues such as the translation of the tests and the time needed for correcting students' answers in mathematics compared with other subjects were also considered. In collaboration with expert teachers and ministry officials from each participating country, we initially developed a specification table covering the basic skills in mathematics that were expected to be taught to students in Grades 3–6 (student age groups 8–12 years) by all participating countries. Thus, the tests covered the following content categories: whole numbers; fractions and proportionality; measurement, estimation and number sense; data representation, analysis and probability; and geometry and patterns. Based on this table, a battery of written tests in English was developed. Item (question) formats included short answer questions (completion and fill in the blank) and problem-solving. To ensure that translation into the Greek language was appropriate, two members of the research team conducted a translation from English to Greek and then a research colleague who was not aware of the initial English version of the tests was asked to translate the Greek version of each test back into English. It was found that the post-translation English version of each test, which derived from translating the Greek version back to English, was identical to the original version of the tests in meaning for all but three items of two tests (i.e. the tests measuring student achievement at the end of Grade 4 and at the end of Grade 5), where small adjustments were made to correct the observed discrepancies. The written tests administered during the main study were subject to control for reliability and validity. The face and content validity of each test was initially evaluated by a group of expert teachers and mathematics teaching academics in each country.

Since our main aim was to generate an overall score of students' achievement in mathematics at the beginning of the intervention and a comparable score of their achievement at the end of the intervention, Item Response Theory (IRT) was used to analyse the data that emerged from students' responses to these tests. However, classical test theory was also used to investigate the reliability and the properties of the test items. Specifically, the conventional item analysis programme ITEMAN was used and item-level statistics per test and country were computed. It was found that the criteria of Cronbach (1990) for the values of the discrimination index and difficulty level of each item were satisfied. Within-country analyses were also conducted to examine the reliability of the findings, by calculating the relevant values of Cronbach's alpha for the scales used to measure student achievement at the beginning and at the end of the intervention per country. Table 1 shows that the internal reliability of each test was very good, since all coefficients of Cronbach's alpha were higher than 0.87. It is also important to note that high inter-item reliability was identified, with all item-total correlations within each test being highly significant. The mean and standard deviation scores of each test per country are also presented in Table 1. By taking into account that a scale from 0 to 25 was used to measure mathematics achievement, one can see that the mean values were close to the midpoint of the scale. This implies that, overall, the students of each country found the tests neither too easy nor too difficult. Moreover, the values of the standard deviations in each country were relatively high. This implies that in each country there was enough variation in the responses of students in each test. Finally, the ceiling and floor effects in the attainment data were not observed, as none of the respondents achieved a full score and none scored zero. Moreover, in each country no more than 14% of the students achieved over 85% of the maximum score and less than 12% of the students achieved less than 10% of the maximum score.

Table 1. Means and standard deviations of scores measuring mathematics achievement at the beginning and at the end of the intervention per grade and country and the values of Cronbach's alpha of each test used to generate the scores.

	Before			After		
Country	Mean	SD	a	Mean	SD	a
Cyprus						
Grade 4	11.21	5.98	0.87	12.29	7.26	0.89
Grade 5	13.82	6.94	0.88	13.91	8.24	0.92
Grade 6	14.11	7.27	0.89	14.28	7.70	0.90
England						
Grade 4	10.38	5.63	0.89	11.60	7.75	0.91
Grade 5	13.18	8.51	0.91	14.62	8.57	0.93
Grade 6	14.73	7.31	0.90	14.29	6.82	0.91
Greece						
Grade 4	10.85	5.63	0.88	13.20	7.95	0.89
Grade 5	12.62	7.78	0.88	13.74	8.19	0.92
Grade 6	13.71	8.09	0.94	14.14	7.91	0.91
Ireland						
Grade 4	13.20	5.30	0.89	13.69	8.18	0.91
Grade 5	13.68	7.56	0.90	14.03	8.53	0.92
Grade 6	14.28	7.49	0.92	14.83	7.59	0.91

Achievement is based on students' total test score on a scale from 0 to 25 (i.e. before running the test equating procedure). Number of participants per country is as follows: Cyprus (n = 1790), England (n = 990), Greece (n = 1286) and Ireland (n = 1494).

At the beginning of the school year, the age of students per grade is as follows: Grade 4 students are expected to be between 9 and 10 years, Grade 5 students are expected to be between 10 and 11 years and Grade 6 students between 11 and 12 years.

Equating of tests

The test administered to Grade 6 students when they were at the end of the school year was purposefully more difficult than the one administered to Grade 4 students when they were at the beginning of the school year, so as to correspond to their age skills, maturity stage and level of mathematics knowledge. As a consequence, we made use of IRT for equating the tests (Hambleton and Swaminathan 1985). Since the tests used to generate scores in the four countries were not in the same language, a decision was made to conduct four separate within-country equating procedures to analyse the data. Specifically, the scores were transformed into the same scale on the basis of the characteristics of IRT models, with students' latent level of ability (y) and difficulty level of an item (b) being identical when certain preconditions were fulfilled (Bond and Fox 2001). The latent ability level for each student could be determined in every version, as long as there were so-called 'anchoring items' connecting the versions. For the purposes of this study, we used sufficient common items (i.e. approximately 15% of anchoring items across all tests) with representative content to be measured (Kolen and Brennan 1995). Estimation was made using the Extended Logistic Model of Rasch (Andrich 1988) and separate within-country analyses were conducted. The within-country analyses revealed that each scale had satisfactory psychometric properties in each country. Therefore, for each assessment period, achievement in mathematics was estimated by calculating the Rasch person estimates.

Student background factors

A student questionnaire (see the web page of the project, www.ucy.ac.cy/promqe), administered at the end of the intervention, was used to collect data on four student background factors: gender, ethnicity, language spoken at home and SES. There were five SES variables available: father's and mother's education level, the social status of the father's job, the social status of the mother's job and the main elements of the home learning environment. However, it should be acknowledged that, in some cases, primary school children were not able to give accurate information about some of the SES variables (e.g. father's and mother's education level) that were asked about in the questionnaire. Data from the student questionnaire measuring SES were analysed by using the Extended Logistic Model of Rasch (Andrich 1988). Analysis of the data revealed that the scale had satisfactory psychometric properties (see Kyriakides, Creemers, and Charalambous 2018a). Thus, a score for the SES of each student was calculated using the relevant Rasch person estimate.

Using a teacher questionnaire to measure school factors

All teachers in the school sample (n = 762) were asked to complete a questionnaire measuring the functioning of the school factors included in the dynamic model in their schools. This questionnaire can be accessed from the web page of the project (www.ucy.ac.cy/promqe). Since it was expected that teachers within a school should be able to evaluate the functioning of each factor in their schools (i.e. teaching policy, SLE and evaluation of school policy) similarly, but differently from teachers in other schools, a generalisability study was initially conducted. For each participating country, one-way analysis of variance revealed that in all questionnaire items, the object of measurement was the school. Reliability was then identified for each school factor by calculating

multilevel λ (Snijders and Bosker 1999) and the Cronbach alpha for data aggregated at the school level. For all factors, the reliability coefficients were high (around .80). It was also found that the percentages of variance at the school level were between 29% and 38%. To test the construct validity of the questionnaire, Structural Equation Modelling (SEM) analysis for each overarching school factor was conducted and the fit indices of all models were found to be satisfactory. Although we conducted separate analyses for each country in order to evaluate DASI, Multiple Group Confirmatory Factor Analysis (MGCFA) (for each overarching factor) was also conducted in order to test whether the teacher questionnaire elicited similar response patterns across the four countries. For each overarching factor, configural invariance was only found to exist, since, for each country, the values of RMSEA were found to be smaller than 0.05 and the values of CFI were higher than 0.94. The lack of metric and scalar invariance makes factor score comparisons invalid, as differing response mechanisms seem to underlie country-group answers to the items for each overarching factor (Brown et al. 2017). However, the purpose of this study was not to compare the overarching factor scores across the four countries but rather to measure the effect of DASI in each country. Thus, the findings of the MGCFA provide further support to our decision to investigate the impact of DASI on promoting quality and equity by running separate within-country analyses.

Analysis of data

The analyses of data were based on three steps. Although a group randomisation study was conducted, we first of all compared the experimental and control groups not only in terms of the prior achievement of their students but also in terms of the three student background factors and the functioning of school factors. This was done in order to make sure that the two groups were comparable, in terms of their student learning outcomes and all factors considered in this study that may affect their effectiveness status in terms of the quality dimension.

Since the equity dimension is measured by investigating the impact of each background factor on student achievement, we initially had to compare the two groups in terms of the effect sizes of each of the three background factors on student achievement at the beginning of the intervention to make sure that these effect sizes were equally strong in the experimental and the control group. Due to the nested character of the data (students within classes within schools), at this second step of analysing data, we ran two separate multilevel regression analyses of student achievement at the beginning of the intervention (one for the experimental and one for the control group) and estimated the effect of each background factor on the prior achievement of students of each group.

At the final stage, multilevel regression analysis of student achievement at the end of the intervention was employed to find out whether students of the experimental group managed to achieve better learning outcomes in mathematics at the end of the school year. In the last model, an interaction effect between each background factor and the dummy variable indicating whether each school made use of DASI (or was part of the control group) was added. In this way, we were able to search for the extent to which the impact of each background factor on final achievement became smaller in the experimental compared with the control group.

Results

This section is divided into two parts. The first part is concerned with the impact of the intervention on promoting student learning outcomes (i.e. quality). Specifically, we will refer to the main results of inferential statistical analyses, which revealed that there were no statistically significant differences in student initial achievement, student background factors and the functioning of school factors between the control and experimental groups. Next, the results of the multilevel regression analysis investigating the impact of the intervention on final achievement are presented, to determine whether the use of DASI can explain variation in student achievement at the end of the intervention. The second part of the results section refers to the impact of the intervention on promoting equity by the identification of any differences in the effect sizes measuring the impact of each background factor on student achievement between the control and the experimental group, at the beginning and at the end of the intervention.

The impact of DASI on promoting student learning outcomes in mathematics

Descriptive data on student background factors, student achievement in mathematics and the functioning of school factors for each country are provided in Tables 2 and 3. One can observe that, in each country, the *t*-test did not reveal any statistically significant difference at the .05 level between the two groups (i.e. experimental and control) in relation to the SES of their students and their prior achievement in mathematics (see Table 2). In addition, the Kolmogorov–Smirnov two sample test did not reveal any statistically significant difference in

Table 2. Descriptive data about the background factors of the students in the experimental and the control group and values of *t*-test per country.

	Experimental		Control		*t*-Test		
Student background factors	Mean	SD	Mean	SD	*t*	df	*p*
Cyprus							
Prior achievement	0.64	1.11	0.68	1.13	−0.76	1788	0.449
Post achievement	1.09	1.15	0.87	1.08	4.16	1788	0.001
SES	0.85	0.73	0.80	0.68	1.49	1788	0.135
Age in days	3805	393	3830	391	−1.58	1788	0.115
England							
Prior achievement	0.78	1.41	0.74	1.38	0.45	988	0.647
Post achievement	1.22	1.40	0.98	1.39	2.69	988	0.007
SES	0.61	0.56	0.64	0.40	−0.97	988	0.331
Age in days	3472	327	3496	342	−1.13	988	0.259
Greece							
Prior achievement	0.72	1.43	0.68	1.35	0.51	1284	0.597
Post achievement	0.98	1.25	0.81	1.16	2.52	1284	0.012
SES	0.65	0.57	0.70	0.58	−1.56	1284	0.123
Age in days	3730	329	3742	328	−0.65	1284	0.513
Ireland							
Prior achievement	0.90	1.32	0.85	1.34	0.72	1492	0.469
Post achievement	1.24	1.29	0.99	1.13	4.14	1492	0.001
SES	0.55	0.53	0.51	0.66	1.29	1492	0.194
Age in days	3926	335	3938	344	−0.69	1492	0.498

Number of participants in the experimental and control groups per country:
Cyprus: experimental (n = 930)/control (n = 860).
England: experimental (n = 489)/control (n = 501).
Greece: experimental (n = 677)/control (n = 609).
Ireland: experimental (n = 803)/control (n = 691).

Table 3. Means and standard deviations of the functioning of each overarching school factor at the beginning of the intervention in the experimental and control schools and values of the Kolmogorov–Smirnov two-sample test per country.

	Experimental school		Control school			
Overarching school factor	Mean	SD	Mean	SD	K–S *Z*	*p*
Cyprus						
School policy on teaching	2.96	0.87	2.98	0.69	−0.766	0.601
School learning environment	3.04	0.77	3.03	0.55	0.656	0.782
School evaluation	2.77	0.73	2.79	0.65	−0.774	0.587
England						
School policy on teaching	3.11	0.86	3.15	0.82	−0.832	0.493
School learning environment	3.05	0.80	3.07	0.90	−0.799	0.547
School evaluation	2.95	0.96	2.93	0.89	0.661	0.765
Greece						
School policy on teaching	3.05	0.83	2.98	0.89	0.914	0.874
School learning environment	3.10	0.72	3.13	0.73	−0.616	0.799
School evaluation	2.71	0.83	2.74	0.28	−0.963	0.312
Ireland						
School policy on teaching	2.98	0.76	3.05	0.69	−0.821	0.502
School learning environment	2.89	0.86	2.84	0.79	0.799	0.547
School evaluation	2.81	0.82	2.87	0.83	−0.963	0.312

the functioning of school factors at the beginning of the intervention between the experimental and the control groups (see Table 3). Regarding the other two student background factors (i.e. gender and ethnicity), the chi-square test did not reveal any statistically significant difference at .05 level between the experimental and control group in each participating country. These results reveal that, at the beginning of the intervention, there was no statistically significant difference at .05 level between the experimental and the control groups in relation to student achievement in mathematics and all explanatory variables at student (i.e. student background factors) and school level (i.e. the functioning of school factors included in the dynamic model). This result can be attributed to the fact that a group randomisation study was conducted (see Connolly, Keenan, and Urbanska 2018).

Finally, the analysis shows that in each participating country, a statistically significant difference in student achievement between the control and the experimental groups at the end of the intervention was observed (see Table 2). Specifically, students in the experimental group were found to have levels of achievement in mathematics higher than those of the control group in each participating country. These results seem to reveal that the intervention had an impact on promoting student learning outcomes in mathematics. However, in order to evaluate the impact of the intervention on student achievement in mathematics at the end of the intervention, within-country multilevel regression analyses were conducted. An empty model consisting of student, class and school levels was initially used. In subsequent steps, explanatory variables at different levels were added, starting at the student level. Explanatory variables, apart from grouping/dummy variables, were centred as *Z*-scores with a mean of 0 and a standard deviation of 1. The models presented in Tables 4–7 were estimated without the variables that had no statistically significant effect at level 0.05.

The following observations arise from Tables 4–7. In model 1, the context variables at each level (i.e. prior achievement, gender, SES, age and ethnicity) were added to the empty model. In each country, prior achievement, SES and gender were found to be associated with student achievement at the end of the intervention. In addition, model 1 was found to explain at least 35% of the total variance in each country. In model 2, the

Table 4. Parameter estimates and standard errors for the analysis of mathematics achievement at the end of the intervention for Cyprus (students within classes, within schools).

Factors	Model 0	Model 1	Model 2	Model 3
Fixed part				
Intercept	0.85 (0.05)*	0.81 (0.05)*	0.56 (0.05)*	0.48 (0.05)*
Student level				
Prior achievement		0.68 (.02)*	0.67 (.02)*	0.66 (.02)*
Gender (0 = boy, 1 = girl)		−0.07 (.02)*	−0.07 (.02)*	−0.07 (.02)*
SES		0.18 (.04)*	0.17 (.04)*	0.23 (.04)*
Age		0.06 (.04)		
Ethnicity (0 = other, 1 = immigrant background)		−0.05 (.04)		
Class level				
Average prior achievement		0.11 (.04)*	0.10 (.04)*	0.10 (.04)*
Percentage of girls		−0.03 (.04)		
Average SES		0.07 (.04)		
Average age		0.04 (.04)		
Percentage of students with immigrant background		−0.05 (.03)		
School level				
Context				
Average prior achievement		0.14 (.06)*	0.13 (.06)*	0.13 (.06)*
Percentage of girls		−0.02 (.04)		
Average SES		0.06 (.04)		
Average age		0.04 (.04)		
Percentage of students with immigrant background		−0.03 (.03)		
DASI (0 = control, 1 = experimental)			0.24 (.02)*	0.25 (.02)*
DASI × SES				−0.13 (.03) *
Variance components				
School	11.2%	9.8%	4.1%	3.1%
Class	17.1%	14.2%	12.1%	10.1%
Student	71.7%	36.3%	35.1%	33.1%
Explained		39.7%	48.7%	52.7%
Significance test				
X^2	6604.4	4862.3	4341.1	4310.0
Reduction		1742.1	521.2	31.1
Degrees of freedom**		5	1	1
p-Value		.001	.001	.001

*Statistically significant effect at .05 level.
**The models presented in this table were estimated without the variables that did not have a statistically significant effect at 0.05 level.

impact of DASI was tested by adding a relevant dummy variable to model 1. By considering the control group as a reference group, it was found that the schools which made use of DASI managed to achieve better results than the control group in each participating country. One could therefore argue that the findings of model 2 reveal that the use of DASI in socially disadvantaged schools had an effect on promoting quality in education in each participating country. It is important to note that the calculations in model 3 reveal that, in each country, there was no statistically significant interaction effect between the use of DASI and any background effect other than SES. Statistically significant interaction effects at the .05 level between the use of DASI and SES were identified in each participating country. These results will be considered further in the next section, which is concerned with the impact of DASI on promoting equity.

The impact of DASI on promoting equity in education

The calculations in model 3, which seek to identify interaction effects between the use of DASI and student background factors on final achievement in mathematics,

Table 5. Parameter estimates and standard errors for the analysis of mathematics achievement for England (students within classes, within schools).

Factors	Model 0	Model 1	Model 2	Model 3
Fixed part				
Intercept	0.99 (0.05)*	0.81 (0.05)*	0.66 (0.05)*	0.56 (0.05)*
Student level				
Prior achievement		0.62 (.03)*	0.62 (.02)*	0.63 (.02)*
Gender (0 = boy, 1 = girl)		−0.08 (.02)*	−0.07 (.02)*	−0.07 (.02)*
SES		0.45 (.04)*	0.44 (.04)*	0.51 (.04)*
Age		0.05 (.04)		
Ethnicity (0 = other, 1 = immigrant background)		−0.06 (.04)		
Class level				
Average prior achievement		0.13 (.04)*	0.12 (.04)*	0.12 (.04)*
Percentage of girls		−0.04 (.04)		
Average SES		0.08 (.04)*	0.08 (.04)*	0.11 (.04)*
Average age		0.06 (.04)		
Percentage of students with immigrant background		−0.06 (.04)		
School level				
Context				
Average prior achievement		0.17 (.06)*	0.16 (.06)*	0.16 (.06)*
Percentage of girls		−0.02 (.04)		
Average SES		0.13 (.04)*	0.13 (.04)*	0.11 (.04)*
Average age		0.04 (.04)		
Percentage of students with immigrant background		−0.03 (.03)		
DASI (0 = control, 1 = experimental)			0.16 (.03)*	0.16 (.03)*
DASI × SES				−0.13 (.03)*
Variance components				
School	14.2%	12.8%	9.5%	8.5%
Class	19.1%	15.2%	12.1%	10.1%
Student	66.7%	33.3%	32.1%	31.4%
Explained		38.7%	46.3%	50.0%
Significance test				
X^2	3051.7	2021.3	1841.1	1800.6
Reduction		1030.4	180.2	40.5
Degrees of freedom**		7	1	1
p-Value		.001	.001	.001

*Statistically significant effect at .05 level.
**The models presented in this table were estimated without the variables that did not have a statistically significant effect at 0.05 level.

can only be interpreted when the impact of background factors on prior achievement in each group are identified and compared. For this reason, two separate within-country multilevel analyses of prior achievement were conducted for each group of schools (see Table 8). In each country, the results of the two separate multilevel analyses of prior achievement revealed that only SES and gender were associated with the achievement of each group of students at the beginning of the intervention. We then converted the fixed effect obtained from each multilevel analysis of SES and gender to standardised effects or 'Cohen's d' by following the approach proposed by Elliot and Sammons (2004). By using this approach, it was found that the effect sizes of SES and gender on prior achievement were equally high for each group of students in each participating country (see Table 9). Since no interaction effect between the use of DASI and gender was identified, one can argue that the impact of gender was equally strong in the two groups of schools not only at the beginning but also at the end of the intervention. This implies that the use of DASI had no effect on promoting equity in terms of the impact that gender has on student achievement. On the other hand, the negative statistically significant interaction effect between the

Table 6. Parameter estimates and standard errors for the analysis of mathematics achievement for Greece (students within classes, within schools).

Factors	Model 0	Model 1	Model 2	Model 3
Fixed part				
Intercept	0.81 (0.07)*	0.67 (0.06)*	0.46 (0.06)*	0.37 (0.06)*
Student level				
Prior achievement		0.52 (.03)*	0.52 (.03)*	0.51 (.03)*
Gender (0 = boy, 1 = girl)		−0.05 (.02)*	−0.05 (.02)*	−0.05 (.02)*
SES		0.35 (.06)*	0.34 (.06)*	0.39 (.06)*
Age		0.07 (.05)		
Ethnicity (0 = other, 1 = immigrant background)		−0.04 (.04)		
Class level				
Average prior achievement		0.21 (.04)*	0.19 (.04)*	0.19 (.04)*
Percentage of girls		−0.03 (.04)		
Average SES		0.05 (.04)		
Average age		0.04 (.04)		
Percentage of students with immigrant background		−0.04 (.04)		
School level				
Context				
Average prior achievement		0.17 (.06)*	0.16 (.06)*	0.16 (.06)*
Percentage of girls		−0.01 (.04)		
Average SES		0.05 (.04)		
Average age		0.02 (.04)		
Percentage of students with immigrant background		−0.01 (.03)		
DASI (0 = control, 1 = experimental)			0.28 (.02)*	0.28 (.02)*
DASI × SES				−0.11 (.02)*
Variance components				
School	13.6%	11.8%	7.1%	5.6%
Class	16.1%	12.2%	8.1%	7.2%
Student	70.3%	36.0%	34.1%	33.0%
Explained		40.0%	50.7%	54.2%
Significance test				
X^2	2790.4	2100.3	1850.2	1805.1
Reduction		690.1	250.1	45.1
Degrees of freedom**		5	1	1
p-Value		.001	.001	.001

*Statistically significant effect at .05 level

**The models presented in this table were estimated without the variables that did not have a statistically significant effect at 0.05 level.

use of DASI and SES (see model 3 of Tables 4–7) seems to reveal that the effect of SES on final achievement was smaller in the schools which made use of DASI in each participating country. Given that the effect of SES on prior achievement was equally strong in the two groups, one could argue that the intervention had an impact on promoting the equity dimension concerned with the impact of SES on achievement in the four participating countries.

Discussion

Some implications for research, policy and practice may be drawn from these findings. First, the findings of this study provide empirical support to the argument that DASI can have an impact on promoting student learning outcomes. Although four experimental studies conducted during the last eight years revealed the added value of using DASI for school improvement purposes on promoting not only cognitive but also affective learning outcomes (see Creemers and Kyriakides 2015), none of them took place in schools in socially disadvantaged areas. Thus, the study reported here moves a step

Table 7. Parameter estimates and standard errors for the analysis of mathematics achievement for Ireland (students within classes, within schools).

Factors	Model 0	Model 1	Model 2	Model 3
Fixed part				
Intercept	0.82 (0.06)*	0.69 (0.05)*	0.45 (0.05)*	0.32 (0.05)*
Student level				
Prior achievement		0.51 (.03)*	0.51 (.03)*	0.50 (.03)*
Gender (0 = boy, 1 = girl)		−0.05 (.02)*	−0.05 (.02)*	−0.05 (.02)*
SES		0.31 (.04)*	0.31 (.04)*	0.35 (.04)*
Age		0.03 (.05)		
Ethnicity (0 = other, 1 = immigrant background)		−0.03 (.04)		
Class level				
Average prior achievement		0.06 (.04)		
Percentage of girls		−0.02 (.04)		
Average SES		0.03 (.04)		
Average age		0.02 (.04)		
Percentage of students with immigrant background		−0.02 (.03)		
School level				
Context				
Average prior achievement		0.13 (.06)*	0.12 (.06)*	0.12 (.06)*
Percentage of girls		−0.01 (.02)		
Average SES		0.03 (.04)		
Average age		0.02 (.03)		
Percentage of students with immigrant background		−0.01 (.04)		
DASI (0 = control, 1 = experimental)			0.32 (.02)*	0.31 (.02)*
DASI × SES				−0.09 (.02)*
Variance components				
School	12.1%	10.8%	7.1%	5.5%
Class	16.1%	13.2%	9.3%	8.2%
Student	71.8%	37.1%	34.5%	32.1%
Explained		38.9%	49.1%	54.2%
Significance test				
X^2	5458.2	4157.1	3937.0	3880.0
Reduction		1301.1	220.1	57.0
Degrees of freedom**		4	1	1
p-Value		.001	.001	.001

*Statistically significant effect at .05 level.
**The models presented in this table were estimated without the variables that did not have a statistically significant effect at 0.05 level.

forward, since empirical support for the argument that DASI can promote quality in different educational settings has been provided. By taking into account that international comparative studies raise the attention of policy makers to the need to promote quality, especially in schools in socially disadvantaged areas, one could argue that this paper has not only significant implications for research on improvement but also for developing policies on equal educational opportunities. This is especially the case as DASI was found to have an effect on promoting student learning outcomes in schools in these areas in each of the four participating European countries.

Second, the answer to the research question concerned with the impact of using DASI for promoting equity seems to be less clear than when considering the impact of DASI on promoting quality. More specifically, one could argue that using DASI in schools in socially disadvantaged areas had an effect on the equity dimension of effectiveness when this dimension is measured by looking at the impact of SES. At the beginning of the intervention, the impact of SES on student achievement in mathematics was equally strong in the schools of the experimental and control groups. However, at the end of the intervention, the impact of SES on student achievement was found to be smaller in the schools of the

Table 8. Parameter estimates and standard errors for the analysis of mathematics achievement at the beginning of the intervention students at the experimental and at the control group per country (students within classes, within schools).

	Cyprus		England		Greece		Ireland	
Factors	Experimental	Control	Experimental	Control	Experimental	Control	Experimental	Control
Fixed part								
Intercept	−0.42 (0.05)*	−0.41 (0.05)*	−0.32 (0.04)*	−0.34 (0.04)*	−0.38 (0.04)*	−0.37 (0.04)*	−0.46 (0.06)*	−0.48 (0.06)*
Student level								
Gender (0 = boy, 1 = girl)	0.09 (0.03)*	0.09 (0.03)*	0.15 (0.03)*	0.17 (0.03)*	0.11 (0.03)*	0.10 (0.03)*	0.17 (0.04)*	0.20 (0.05)*
SES	0.34 (0.05)*	0.32 (0.05)*	0.29 (0.05)*	0.27 (0.05)*	0.38 (0.05)*	0.36 (0.05)*	0.28 (0.05)*	0.30 (0.05)*
Age	0.12 (0.04)*	0.11 (0.04)*	0.11 (0.04)*	0.11 (0.04)*	0.13 (0.04)*	0.12 (0.04)*	0.16 (0.04)*	0.16 (0.04)*
Ethnicity (0 = other, 1 = immigrant background)	−0.08 (0.05)	−0.07 (0.05)	−0.12 (0.04)*	−0.10 (0.04)*	−0.11 (0.04)*	−0.12 (0.04)*	−0.15 (0.05)*	−0.16 (0.05)*
Class level								
Percentage of girls	0.04 (0.06)	0.05 (0.06)	0.06 (0.06)	0.08 (0.06)	0.06 (0.06)	0.06 (0.06)	0.03 (0.04)	0.03 (0.04)
Average SES	0.06 (0.04)	0.06 (0.04)	0.07 (0.04)	0.07 (0.04)	0.07 (0.04)	0.05 (0.04)	0.06 (0.04)	0.07 (0.04)
Average age	0.08 (0.03)*	0.09 (0.03)*	0.08 (0.03)*	0.09 (0.03)*	0.08 (0.03)*	0.09 (0.03)*	0.11 (0.03)*	0.12 (0.03)*
Percentage of students with immigrant background	−0.03 (0.04)	−0.04 (0.04)	−0.04 (0.04)	−0.04 (0.04)	−0.06 (0.04)	−0.04 (0.04)	−0.07 (0.04)	−0.06 (0.04)
School level								
Context								
Percentage of girls	0.02 (0.04)	0.01 (0.04)	0.03 (0.04)	0.03 (0.04)	0.02 (0.04)	0.03 (0.04)	0.03 (0.04)	0.04 (0.04)
Average SES	0.05 (0.03)	0.04 (0.03)	0.14 (0.03)*	0.15 (0.03)*	0.08 (0.03)*	0.09 (0.03)*	0.12 (0.03)*	0.13 (0.03)*
Average age	0.03 (0.06)	0.04 (0.06)	0.03 (0.06)	0.03 (0.06)	0.03 (0.06)	0.03 (0.06)	0.05 (0.06)	0.04 (0.06)
Percentage of students with immigrant background	−0.05 (0.02)*	−0.04 (0.02)*	−0.05 (0.02)*	−0.06 (0.02)*	−0.07 (0.02)*	−0.06 (0.02)*	−0.11 (0.02)*	−0.10 (0.02)*
Variance components								
School	10.8%	10.5%	8.8%	8.5%	9.1%	8.9%	10.1%	9.9%
Class	13.2%	13.3%	11.2%	12.2%	13.2%	13.4%	12.9%	13.5%
Student	37.1%	38.1%	40.1%	38.1%	41.5%	41.0%	39.5%	40.1%
Explained	38.9%	38.1%	39.9%	41.2%	36.2%	36.7%	37.5%	36.5%

*Statistically significant effect at .05 level.

Table 9. Effects (in Cohen's *d* values) of SES and gender on achievement at the beginning of the intervention of students at the schools of the control and experimental group per county.

	Experimental Group	Control Group
CYPRUS		
SES	0.31	0.29
Gender	0.11	0.10
ENGLAND		
SES	0.28	0.27
Gender	0.12	0.13
GREECE		
SES	0.35	0.36
Gender	0.09	0.08
IRELAND		
SES	0.27	0.28
Gender	0.13	0.14

experimental group in comparison with the schools of the control group. These findings indicate that schools in the experimental group became more effective than those of the control group in terms of equity, as, in these schools, the achievement gap based on SES was smaller, whereas at the beginning of the intervention the achievement gap had been equally large. It should be acknowledged here that DASI was found to have an effect on promoting student learning outcomes and, thereby, its impact on equity did not have any negative effect on promoting quality. On the contrary, schools of the experimental group were found to be more effective in terms of both quality and equity. However, DASI was not found to have an impact on equity when this dimension of school effectiveness was examined by focusing on the achievement gap based on gender and on the achievement gap based on ethnicity. These findings reveal the importance of measuring equity in terms of the student achievement gaps based on different background factors, rather than only SES, and evaluating the impact of interventions on promoting equity by using various criteria (Kyriakides, Creemers, and Charalambous 2018a). At the same time, the findings of this study seem also to reveal that there is no criterion consistency in measuring equity, especially as policies and actions might be implemented for addressing equity in relation to specific groups of students (in this study, based on their SES) rather than through a more holistic approach that emphasises the fairness of education in terms of all disadvantaged groups of students, in relation to the achievement of specific learning objectives. Further research is, nevertheless, needed to find out whether equity should be treated as a multidimensional construct. Such studies may not only examine equity by looking at achievement gaps based on different background factors but may also search for consistency in terms of the type of learning outcome that is considered each time. It is therefore acknowledged, as a limitation of this study, that it was only possible to measure student cognitive learning outcomes in a single subject – namely, mathematics.

Thirdly, the fact that DASI was not found to have an effect on reducing student achievement gaps based on gender and ethnicity could be attributed to the emphasis given on the impact of SES rather than other background factors in the theoretical framework of this intervention. As has been mentioned above, DASI supports the use of a theory-driven and evidence-based approach to school improvement and makes use of the dynamic model of educational effectiveness in its attempt to raise attention not only

to promoting quality and equity but also to identify specific school factors that need to be considered in promoting student learning outcomes. The dynamic model refers to the impact, on student achievement, of various student background factors that are unlikely to change. Based on this group of factors, it attempts to use a multidimensional approach in measuring equity. However, it must be borne in mind that the dynamic model gives more attention to why and how SES can influence learning rather than any other background factor (see Kyriakides, Creemers, and Charalambous 2018a). The emphasis on a single background factor (i.e. SES) can be attributed to the fact that the model emerged from research on school effectiveness. This has its origins in reactions to early research on equal opportunity, arguing that, after controlling for the impact of SES, nothing is left for the schools to explain variation in student achievement (Brookover et al. 1979; Rutter et al. 1979). Although meta-analyses of studies investigating the impact of SES did not provide support for this claim, one can see that almost all effectiveness studies were concerned with the impact of SES on achievement and gave less attention to the impact of other background factors such as gender and ethnicity. This is not only reflected in the methodology that is used in this field (see Creemers, Kyriakides, and Sammons 2010) but also in its attempts to explain why, and under which conditions, background factors such as gender and ethnicity may influence learning (Kyriakides, Creemers, and Charalambous 2018b; Scheerens 2013). To some extent, this emphasis on the impact of SES in the dynamic model has influenced the design and the content of the project's handbook (see the web page of the project, www.ucy.ac.cy/promqe) as well as the support that schools received in addressing equity in terms of SES rather than in terms of all student background factors. As a consequence, some experimental schools developed policies and actions promoting equal opportunities by considering only the impact of SES. These policies and actions might not be relevant when it comes to improving equity in terms of other background factors (e.g. gender and ethnicity) that are unlikely to change. As a consequence, the study presented here revealed that DASI can promote equity in terms of reducing achievement gaps between students coming from different socioeconomic backgrounds. However, this intervention had no impact on reducing the achievement gaps between students with differences in two other background variables, namely, gender and ethnicity. Therefore, other studies may be needed to investigate the extent to which policies and actions which address equity in a more comprehensive way are either effective in promoting equity in terms of each background factor, or are less effective when compared with policies that are focused on specific groups of students.

Fourth, the observed impact of DASI on promoting quality and at least one dimension of equity (i.e. the achievement gap in terms of SES) seems to provide some support to the argument that authentic changes designed to improve equity come from interventions taking place at the school level. We argue here that the use of DASI stimulates a special approach to improvement, whereby each party has a specific role in, and contributes expertise to, the intervention and thus ownership is assured. The relationship established between the school and the A&R Team suggests the main difference between DASI and other school improvement approaches that follow a top-down approach, giving emphasis only to available knowledge that has emerged from educational effectiveness studies and not to the existing problems, situations, professional needs and abilities of the schools' stakeholders (teachers,

students, parents). Thus, we believe that this dynamic approach can be used by stakeholders, especially when it is necessary to deal with improving the effectiveness status of schools situated in disadvantaged areas, since these schools have to face problems that require special attention and handling according to their context. Policy-makers should be able to support them in implementing such an approach by providing them with all the necessary learning resources. This includes, in particular, an A&R Team that can help them identify improvement priorities, and then design, implement and evaluate school improvement strategies and action plans that take into account the knowledge base of EER.

Fifth, it should be acknowledged that one of the most important parts of an intervention programme is not only the investigation of its immediate impact on school policy and on student learning outcomes, but also an exploration of the sustainability of its effects. Sustainability can be defined as maintenance of achieved outcomes and effects of an intervention programme beyond its completion. This means that teachers and schools should be able to use the knowledge gained from the intervention programme, even after it has ended. Thus, further research investigating the sustainability of using DASI for promoting student learning outcomes is needed. It is important to acknowledge here that almost all schools in the experimental group asked whether each country research team could support them in using DASI for an extra school year. Although this was not part of the original research proposal, three country teams (i.e. Cyprus, Greece and Ireland) were able to provide support to schools in order to implement DASI for two consecutive school years using additional resources. Analysis of the data that emerged from the second phase of this project may reveal the added value of using DASI for more than one school year in promoting quality and equity in education. Such research may also help policy-makers develop systematic policies supporting schools to promote quality and equity, including the consideration of issues such as the optimal duration of the intervention (Kyriakides et al. 2017) and the differentiated support that each school may have to receive in implementing DASI for a period of time longer than a school year.

Finally, future research could also address issues related to the scalability of interventions based on DASI. This is particularly important, as the provision of an A&R Team is an element of DASI that makes improvement projects based on DASI more expensive than other school improvement approaches. Further research on schools using DASI for a longer period of time than a school year may reveal how the roles of school stakeholders and the A&R Team may change over time. Given that DASI depends on the collaboration between the school stakeholders and the A&R Team, it is important to determine whether stakeholders in schools which have used this approach for a long period of time are now able to run their projects with minimal, or even without the need of, substantial assistance from the A&R Team. As Block (1999) argues, one of the most challenging tasks of a coaching team is to build local capacity in the school organisation. By identifying changes in the role of the A&R Team and school stakeholders over time, possibilities for scaling up intervention projects based on DASI may also emerge.

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