Title: ***Developing 21st Century Skills in Early Childhood: the contribution of process quality to self-regulation and pro-social behaviour***

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Keywords: preschool, curriculum, quality, 21st century skills, self-regulation

Acknowledgement: This paper is based on research that was funded by the UK Department for Education (EPPSE study) and the European Union Framework 7 (CARE research project)

Journal: ZfE

Abstract

There is a rich tradition in Europe of child-centred Early Childhood Education and Care (ECEC) with social development as the predominant curricular goal and free play as the main pedagogical principle for development. This tradition has been challenged by recent research showing that young children benefit from more structured learning, often called 'guided play'. Moreover, the predominant goal of social development has been challenged by a recent survey of curricular goals in European countries that found wide support for '21st century' skills such as self-regulation and some limited support for 'emerging' academic ones. This paper argues for the importance of observed process quality as the educational driver supporting the development of 21st century skills in the pre-school years. Based on multi-level models of children's developmental progress in a large, longitudinal study in England, the findings demonstrate the contribution of process quality in ECEC to the development of self-regulation and pro-social behavior (key 21st century skills) as measured at the end of primary school.

Developing 21st Century Skills in Early Childhood: the contribution of process quality to self-regulation and pro-social behaviour

Background

The last thirty years have seen rapid expansion in early childhood education (ECEC) across the globe, with both high and low income countries increasing their investments (Kagan & Landsberg 2019). All European countries have changed their policies and provision (Sylva, Ereky-Stevens & Aricescu, 2015), with many placing all ECEC under one government ministry (typically Education) and others bringing together the *care* of children between birth and 3 with the *education* of children 3-6. In some European countries these two age groups had traditionally been located within different ministries, often with Health responsible for birth-3 and Education for children 3-6 years. Many influential research reviews (Melhuish, Ereky-Stevens 2015; Ulferts & Anders 2016; Yoshikawa, Weiland et al. 2013; Pianta, Barnett, Burchinal & Thornburg 2008; Shuey & Kankaraš 2018) demonstrate the beneficial effects of ECEC and care on children's development, benefits that remain throughout the primary school phase but sometimes extend to the end of compulsory schooling and even into adulthood (Barnett 2011; Dammrich and Esping-Andersen 2017; Sammons, Toth & Sylva 2018).

Optimism reigned in the first decade of the century with mounting evidence that ECEC can enhance the development of all young children (Sylva, Melhuish, Sammons, Siraj-Blatchford, & Taggart 2010; Melhuish, Sylva et al. 2008; Pianta et al. 2009; Anders, Rossbach et al. 2012; Anders, Grosse, Rossbach., Ebert & Weiner 2013). Many went further and argued that ECEC would diminish the large discrepancies in school-entry profiles of children from different social and cultural backgrounds (OECD 2017). However, despite widening participation of poor and marginalised children in ECEC, there remains a disturbing gap between children from differing social backgrounds in language development, pre-literacy and pre-numeracy skills at entry to primary school (Gambaro, Stewart, & Waldfogel 2014; Blossfeld, Kulic, Skopek, & Triventi 2017; Blanden, Del Bono, McNally & Rabe 2016). Is ECEC 'effective' for all children, and why is it so difficult to narrow the attainment gap between rich and poor children (Sylva 2014; Taggart et al. 2014)? What might be the role of curriculum in explaining effects or lack of them?

The CARE study of the ECEC Curriculum in Europe

We turn now to curriculum and its goals. Although total expenditure and governance related to ECEC are changing rapidly (Kagan & Landsberg 2019), so too is the curriculum. The ambitious EU project CARE (Moser, Leseman, Melhuish, Broekhuizen & Slot 2017) made an extensive study of the curriculum in eleven European countries that included those from the north and south, with high and lower incomes, and with widely different cultural traditions (Sylva, Ereky-Stevens & Aricescu 2015). The CARE research (Moser et al. 2017) aimed to develop 'an evidence-based and culture-sensitive European framework of developmental goals, quality assessment, curriculum approaches, and policy measures for improving the quality and effectiveness of early childhood education and care'.

The CARE study used document scrutiny alongside stakeholder surveys and interviews to address the question:
What are the domains of development that the ECEC Curriculum does/should address to support optimal development in young children?
First, national documents were analysed in eleven European countries to identify goals for each national curriculum (Sylva et al. 2015). Next, researchers (Broekhuizen, Leseman, Moser & van Trijp 2015) carried out surveys in nine (of the eleven) European countries to discover the views of stakeholders about 'important curricular goals for children in their country'. Three groups of stakeholders were surveyed and these included parents, ECEC staff and local policy makers. The surveys were supplemented by focus group discussions with teachers and policy-makers. All in all, approximately 2500 parents participated in the surveys, 2172 ECEC staff, and 277 policy makers with varying participation rates across the nine countries. This mixed method study integrated quantitative date from surveys, policy documents and qualitative data from interviews and discovered coherent themes in the views of the different respondents.

What the researchers found from policy documents and stakeholder surveys/interviews was broad agreement in favour of a 'strong socio-emotional orientation' in the curriculum, including children's confidence, social participation, sense of identity, and sense of belonging' (Sylva, Pastori, Lerkkanen, Ereky-Stevens & Slot 2016). However, many countries (but certainly not all) also had curricular goals related to children's acquiring 'emergent' literacy and numeracy skills. The social-emotional focus (found in all countries in the study) and academic focus (found in some countries, especially England) were clearly present in the last century and continue to the present. What the CARE project found was a balanced view that placed equal weight on social and academic competencies. What was new, however, in the responses of policy-makers and staff was the add'21st Century skills' (Geisinger 2016; Siraj 2017). 'The last decade has witnessed a more (balanced) view between children's social and academic competencies, but also emphasizes processes and skill development related to *self-regulation, problem-solving, creativity and collaboration'* (Sylva et al. 2016, p. 12). These 21st century skills are sometimes called 'soft' skills to distinguish them from the 'hard' skills such as letter recognition that are part of academic school readiness.
This work led to the CARE Project framework for analysing the curriculum in nine European countries presented in Table 1. The three columns refer to three broad types of curricular goal found in the national documents and in the stakeholder surveys: these include goals for:

[insert Table 1]

social development, *21st century skills*, and *academic knowledge*. The list of social and emotional goals was strongly endorsed by all nine countries in the CARE sample. The list of academic goals was endorsed strongly in several countries. The new 21st century skills that emerged from the survey respondents are presented in the middle column of Table 1 and include self-regulation. Self-regulation can be thought of as a broad set of meta-cognitive skills deriving from 'executive functions' (Blair & Razza 2007) but also including a socio-emotional component. Although few countries have fully integrated self-regulation into their

national curriculum (with the exception of Finland; see Kangas., Ojala & Venninen 2015) many countries in the CARE sample were actively planning to include self-regulation in future curriculum reforms. For example, the most recent reform of the English Early Learning Goals (UK Department for Education 2019) has added self-regulation to its list of 17 statutory goals to be achieved by every child.

Are some curriculum goals more important than others? The CARE researchers found that 'parents gave higher importance ratings (compared to staff) to children's "soft" interpersonal, emotional and personal skills compared to the "hard" pre-academic skills. This difference (between parents and staff) was less strong for children between age 3 and 6, although it was still apparent in some countries' (Broekhuizen et al. 2015, p. 86). When CARE researchers interviewed teachers and policy-makers, many mentioned as 'important' the cognitive processes that underpin learning. These cognitive processes are not outcomes of learning such as alphabet letters; instead they are the underpinning processes of learning itself. Such underpinning processes include critical thinking and reasoning, problem solving, planning, decision-making, curiosity, perseverance, and self- regulation.

The research literature on self-regulation has grown exponentially in the last decade and prominent European policy documents now focus on the role of early childhood education in fostering it (Shuey and Kankaras 2018). Several studies demonstrate the links between early self-regulation and later academic and social skills (e.g., Raver et al. 2011; Hammer et al. 2017, 2018) as well as general well-being (Moffitt, Arseneault et al. 2011). In their recent research review for OECD, Shuey and Kankaras (2018) came to the same conclusion as CARE about the importance of 21st century skills, especially self-regulation, in underpinning success in adult life. However, Siraj (2017) argues forcefully that the cognitive and socio-emotional strands of 21st century skills are so intertwined that they need to be considered together in what she calls 'intentional pedagogy'. 'There is a growing emphasis on integrated learning in ECED that creates a connection between the academic and the social. The development of children's competencies in creativity, collaboration, self-regulation and problem-solving can be undertaken through projects which require young children (especially those aged three to five) to communicate and create knowing together. Here, the important task of the educator is to emphasize, and give attention to, the learning process rather than the learning outcomes' (p.147). Although academic and social goals need to be considered together when practitioners plan and lead children's learning, we have kept them separate in this paper for analytic clarity and to conform to the dominant literature that assesses self-regulation and social skills in very different ways.

The CARE findings are not confined to study of the ECEC curriculum and its goals. Although national curricular frameworks are respected in all countries, the CARE research demonstrated that it is day-to-day practice (often called process quality) that is the more powerful engine supporting children's learning and development (Slot 2018). Through intensive case studies of ECEC practice in six of the CARE sample countries (Slot et al. 2016a), combined with secondary analyses of national datasets (Slot et al. 2016b), the CARE team delved deeply into practices that shape children's learning. The secondary analysis and

the intensive case studies both point to the vital role of observed process quality in fostering child development and learning. Figure 1 shows how curriculum is only one of the many influences on daily practice; others include resources, political traditions, national values and the social context of distinct communities (See Kagan and Landsberg 2019). The goal of this paper is to demonstrate through Europe's largest longitudinal 'effectiveness' study the contribution of observed process quality during the preschool years to the development of two 21st century skills (self-regulation and pro-social behavior) in children when they are age 11 years.

[Insert Figure 1]

Many research studies over the last thirty years have shown that the quality of practice (or process quality) makes a substantial difference to children's learning (Sylva et al. 2011; Slot 2018; Vandell et al. 2016). In fact, a study by Sylva et al. (2011) showed that low quality provision led to outcomes that were no better than not attending preschool at all.

Introducing the EPPSE Project

The Effective Pre-school, Primary and Secondary Education Project (EPPSE) is a large scale, longitudinal study that allows exploration of the following question:
Does quality of preschool practice have an effect on the development of 21st century skills?
The EPPSE project is Europe's largest longitudinal investigation into the effects of preschool, primary and secondary education on children's developmental outcomes. Commissioned in 1996 by the U.K. government, EPPSE adopted an 'educational effectiveness' design using mixed methods (Sammons et al. 2005; Siraj-Blatchford et al. 2006; Sylva et al. 2010a; Taggart et al. 2014). The main objective from the policy perspective was to identify the 'value added' by preschool education and the effects of different types of provision (e.g., high v low quality, public v private) on subsequent child development and attainment. Using multilevel modelling, the researchers established, among other things, the contribution of child, family, home environment, and school characteristics to children's academic progress (especially national tests) and their social-behavioural development in the period between 3 and 16/18 years (Sylva et al. 2010a; Sammons et al. 2008a, 2008b, 2008c; 2014a, 2014b; 2018). In other words, at the core of EPPSE are questions about how the developmental trajectories of children are shaped by their early educational environment (Siraj and Mayo 2014). The focus in this paper will be the effects on children's development of process quality, as measured by the Early Childhood Environment Rating Scale (ECERS-R) (Harms et al. 1998) and its British curricular extension, the ECERS-E (Sylva, Siraj-Blatchford & Taggart, 2010).

Below is a brief overview of key features of the EPPSE research design and the characteristics of the sample, followed by the main findings that pertain specifically to the effects of quality on children's development at the end of primary education. For detailed findings from the EPPSE study visit: https://www.ucl.ac.uk/ioe/research-projects/2019/mar/effective-pre-school-primary-and-secondary-education-project-eppse

Note that the empirical findings summarized below describe children's outcomes over time, some outcomes relate to the social-emotional domain, some to the academic, and others to 21st century curricular goals. The term 'effects' is used in this paper to refer to statistical associations between predictor measures and later developmental outcomes, controlling for confounding variables. It is stressed that such correlational research cannot substantiate strong causal inferences. However, the longitudinal statistical models powerfully demonstrate the typical trajectories of children from different backgrounds who attended different kinds of preschools over subsequent phases of education.

Methods

Sample

A total of 141 target preschool centres was drawn randomly from five regions across England, selected to cover a range of socioeconomic and geographical areas, including economic and ethnic diversity. Pre-school centres were randomly sampled from six types of provision: ECEC (nursery) classes in primary schools, voluntary/charitable playgroups, local government day-care nurseries, private day nurseries, and integrated centres combining education, health and care. Figure 2 shows that the study drew approximately equal numbers of centres from each types of provision (which appear in rectangles on the left side of the figure) and that approximately 500 children from each of the main types of provision were randomly selected.

[Insert Figure 2]

As illustrated in Figure 2 more than 2800 children were recruited at the start of preschool (around age 3) and followed until leaving education at age 16 or 18. (For EPPSE findings specifically focused on outcomes at the end of compulsory schooling, visit https://www.gov.uk/government/publications/influences-on-students-development-at-age-16. Also see Sammons et al 2018). An additional 310 'home' children with no preschool experience were recruited at age 5 from the primary schools attended by the EPPSE children. The EPPSE sample is broadly representative of England when compared to the English census and consisted of roughly equal numbers of boys and girls. Altogether 74% of the children were of White U.K. heritage and for 11% of the children English was an additional language (EAL). Family socioeconomic status (SES) was diverse with over 30% of families classified located in the two highest (professional) occupational categories and 16% were unemployed or not working. Lastly 16% of the children were eligible for the poverty-indicator 'free school meals' (FSM) (Sammons et al. 2008c).

Child Assessments

A comprehensive developmental profile was established for each child, which included academic tests and linguistic assessments (1:1 assessments for the youngest children, followed by national tests at school, social and emotional assessments (rating scales completed by preschool workers and school teachers) and self-reports completed by the children after the age of 7. The longitudinal child assessments at ages 3, 5 (Table 2), and 11 (Table 3) form the core of this paper and were supplemented by parental interviews and questionnaires.

The children were assessed at the start of preschool (mean age 39.8 months, sd 4.3) on four subscales from the British Ability Scales (BAS-II; Elliott et al. 1996).

[Insert Table 2 here]

The first two tests assess receptive and expressive verbal language skills, and the second two tests assess non-verbal reasoning and spatial awareness skills. They were also assessed by preschool staff on social-behavioural development. At entry in primary school, the BAS-II measures were re-administered and two additional code-related measures were added to assess letter recognition and phonological awareness skills. At age 11 children took national tests in English and Mathematics (hard skills) and class teachers completed a profile devised for this study of social-emotional-behavioural development (soft skills or 21st century).

[Insert Table 3 here]

Preschool Quality Assessments

Two environmental rating scales assessed the process quality in 141 preschool centres. ('Structural' quality denotes enduring characteristics of provision such as the facilities, resources, child-staff ratios and staff qualifications while 'process' quality refers to daily interactions, emotional tone and daily routines.) The American ECERS-R (Harms et al. 1998) is one of the most widely used observational measures for describing the process quality of ECEC. The ECERS-R assesses structural resources like space/furnishings as well as processes including social interactions and daily routines. The 43 items are divided into 7 subscales: Space and furnishings, Personal care routines, Language reasoning, Activities, Interaction, Program structure, and Parents and Staff. Completion of the ECERS-R required at least half a day of observation, as well as talking to the staff about aspects of the routine that were not visible during the observation session (e.g. weekly swimming or seasonal outings). Each item is rated on a 7-point scale (1 = inadequate, 3 = minimal/adequate, 5 = good, 7 = excellent. The psychometric strength of this instrument has been demonstrated in past studies (Sylva et al. 2006), and high inter-rater reliability was established with Kappas ranging from .83 to .97.

The American ECERS-R was believed to be insufficiently focused on learning/teaching processes and therefore the EPPSE researchers devised the ECERS-E (Sylva et al. 2010b). The English curriculum concentrates heavily on 'emergent skills', especially literacy and numeracy (Sylva et al. 2019) and the new rating scale was designed to supplement the ECERS-R with four curricular subscales: Literacy, Numeracy, Science, and Diversity. The Diversity sub-scale assesses the extent to which the three curriculum areas are implemented with respect to children of different genders, cultural/ethnic groups, and varying levels of ability. Like the ECERS-R, each subscale consists of a range of items scored on a 7-point rating system. High inter-rater reliability was established (Kappas ranging from .83 to .97) and observations took a full day.

Table 4 shows the sub-scales of the global quality scale (ECERS-R) and the specific curricular scale (ECERS-E). Note that the ECERS-R assesses a wide range of process quality

domains but its breadth makes it a 'global' assessment tool. In contrast, the ECERS-E delves deeper into observed learning/teaching interactions as they are scored within specific curriculum areas of (emergent) literacy, numeracy and science. Because of its greater emphasis on domain-specific interactions, the ECERS-E is referred to as a measure of curricular process quality and the ECERS-R as a measure of 'global' process quality.

[Insert Table 4 here]

Findings

Researchers who visited the centres anecdotally reported striking differences. Many centres, especially in the government sector, appeared to be exciting places where children were challenged and supported in their learning and where interactions between staff and children appeared sensitive and enabling. Unfortunately, in other centres daily practice lacked structure or children were observed completing mindless worksheets. These subjective impressions were confirmed by the ECERS observations. Sylva et al. (2006) reported on the range of ECERS-E scores in 141 EPPSE centres. Moreover, Sylva showed that scores on quality were significant predictors of children's development at school entry after taking into account pretest scores at age 3 and family background.

In the Sylva paper and other reports from the EPPSE project (Sammons et al. 2004, 2008a, 2008b, 2008c), the analytic strategy was to create statistical models predicting children's developmental outcomes after control for pre-test and a host of individual (e.g., gender) and family (e.g. SES) covariates. Thus, value-added models were created to investigate the effects of preschool experience on children's progress over time (i.e. academic or social gains) **after controlling fo**r their prior attainment and a long list of demographic and environmental variables known to be important drivers of developmental progress. While space constraints do not allow presentation of full statistical analyses, please see Sammons et al 2004, 2008a, b & c for details of statistical modelling. Because significant subgroup differences in academic attainment were identified at pre-school entry and throughout primary schooling (e.g. relating to gender, ethnicity and mother-tongue, family size, parental education, family SES etc.) these variables were all treated as covariates in the hierarchical models summarized below.

Impact of Preschool Quality on Cognitive Development at age 5

Value-added models predicting children's emergent academic skills between ages 3 and 5 are first described, followed by value-added models predicting a range of outcomes at age 11. What is new in this paper is the addition of two 21st century skills to the basket of outcomes; although many studies have established the relationship between quality and children's academic outcomes, few studies explore the contribution of quality to the development of self-regulation or pro-social behaviour.

Table 5 presents a condensed summary taken from the value-added models (See Sammons, Elliot, Sylva, Melhuish, Siraj-Blatchford, & Taggart 2004 for details). It shows significant results (but without effect sizes) of the impact of quality of preschool provision on children's school entry profiles at age 5. Only significant effects are reported (with positive denoting a significant effect after control for child, parent, family, home environment and other

preschool characteristics). There are significant positive associations between the preschool centre's total ECERS-E score and children's progress in the hard skills of phonological awareness and letter knowledge as well as non-verbal reasoning.

[Insert Table 5]

Table 5 suggests that one of the powerful drivers of school readiness is domain-specific process quality related to 'academic' curriculum measured by the ECERS-E, but not the more global quality measured on the ECERS-R.

Although quality of preschool provision predicted children's developmental progress, the length of time they were enrolled (measured in years/ months) was also associated with gains. Figure 3 shows

[Insert Figure 3]

the associations of quality measured by ECERS-E with children's code-related skills along with the duration of their attendance ('low' is less than 1 year and 'high' more than 3 years). Quality and duration of attendance work together to support code-related literacy skills, arguably the most important academic skill at the start of formal schooling. The strong link with duration is evidence that the longer children are exposed to high quality, the higher their scores at post-test, sometimes called a 'dose effect'. For ease of interpretation, net effect sizes (ES) are reported on the vertical axis in all bar graphs that follow. Details of the full models can be found in other EPPSE publications (Sammons et al. 2002, 2004, 2008a, 2008b; Sylva et al. 2010a).

Impact of preschool quality on children's academic attainment at age 11

All children in England take national exams at the end of primary education in English (reading, writing, spelling) and Mathematics. After control for baseline and background covariates, the domain-specific process quality on the ECERS-E is a significant predictor of children's academic performance at age 11, whereas general (or global) quality on the ECERS-R is not. Of particular note for equity, the effect of quality was stronger for children whose mothers had low levels of education than for the children of better educated mothers (Sammons et al. 2008; Sylva et al. 2010a), suggesting that quality is more important for children from disadvantaged families.

[Insert Fig 4 here]

Impact of preschool quality on children's 21st century skills at age 11

EPPSE measured 21st century skills in two areas: *self-regulation* or the capacity for task focus and persistence, and *pro-social behaviour* or their teamwork skills at interacting with peers. (Items comprising these scales appear in Table 3). Figure 5 shows that both domain-specific process quality (ECERS-E) and global quality (ECERS-R) predict higher self-regulation scores after control for baseline and background factors. Items on this subscale suggest that children high in self-regulation 'like to work things out for self' and 'persist in the face of difficulty'.

[Insert Figures 5 and 6 here]

The two quality scales also predict higher pro-social behaviour. Items on this sub-scale include 'kind to other children' and 'volunteers to help others'. The positive effect of quality on pro-social behavior is shown in Figure 6. Together, Figures 5 and 6 make a convincing case for the substantial role of global and domain-specific quality in supporting the development of 21st century skills. It is important to stress that the benefits in 'soft' skills did not come at the expense of high performance in 'hard' skills tested in the national assessments. Finally, it is also important to stress that all the children in EPPSE preschool sample experienced the same national curriculum, government inspections and legal ratios: what varied was the process quality of their centre.

Discussion

The EPPSE longitudinal study has demonstrated that process quality measured by the ECERS-E and ECERS-R makes a significant contribution to the development of two 21st century skills that underpin success at school and later adult life. EPPSE is not the only study to show the effect of quality on these skills, but its large and broadly representative sample give it ecological validity and the long term follow up to age 18 (Sammons et al 2018) enables predictive validity to be tested across different phases of education over time. The children in the sample were ordinary children attending very typical ECEC centres across the country. If governments want return on their investment in early childhood, then EPPSE suggests that provision of medium to high quality is 'delivering the promise' and it may be more important for children from disadvantaged backgrounds. This last is demonstrated by the differential effect of quality on academic outcomes at age 11; children whose mothers had lower levels of education made more progress than children with better educated mothers (Sammons et al. 2008; Sylva et al. 2010a).

Is self-regulation at age 5 merely the 'consequence' of ECEC, or expressed more simply, is it merely a main effect? Dilworth-Bart (2012) showed that executive function at school entry *mediated* the relationship between the home environment during the preschool years and children's subsequent mathematical skills. It is possible that self-regulation at age 5 acts as a mediator in a pathway between the quality of preschool learning at home and school and final developmental outcomes at age 11. The precursor to the EPPSE self-regulation measure at age 11 was a rating scale measure at age 5 called 'Independence and concentration' (Sammons et al. 2008). We hypothesize that self-regulation at school entry (measured by the teacher-reported score on 'Independence and concentration' scale) mediates the relationship between the quality of preschool provision and later academic and social-behavioural outcomes. Our stylized Figure 7 shows the hypothesized pathway of mediation.

[Insert Figure 7 here]

This mediation model is supported by earlier EPPSE analyses (Sylva et al. 2011; Sammons et al. 2008c) showing that preschool quality not only predicts school entry skills ('school readiness'), but that children who had attended higher quality preschools **made more academic progress** between the ages of 7 and 11 when compared to peers who attended centres of lower quality. This suggests that children who had attended the higher quality

centres in the preschool period were better able to benefit during primary education through using their higher levels of self-regulation. It is tempting to conclude that they had 'learned how to learn'.

The EPPSE study has many limitations. First, it is based on a correlational design and not a causal experiment, meaning that it shows 'likely' or 'typical' pathways from high quality early experiences to later outcomes on 21st century skills. Although EPPSE has not experimentally manipulated quality to explore child outcomes, powerful statistical controls go some way to suggesting plausible causal pathways. However, there are many smaller scale, experimental studies showing that high quality early education experiences lead to beneficial outcomes, with the most widely cited by Barnett (2011). Moreover, a range of newer longitudinal studies in Europe now provide evidence similar to that of EPPSE on the effects of preschool quality (see Sammons et al. 2013). Another limitation was that quality was measured at only one time point and that the same researcher scored the ECERS-R and ECERS-E. To balance these limitations, the sample is a large and representative one using multiple and valid child assessments over time. Its use of the ECERS-R is justified by the fact that this instrument was the most widely accepted in the year the assessments were carried out.

A string of EPPSE papers has pointed to the apparent protective effects of high quality preschool especially for promoting academic skills in disadvantaged children (Sammons et al. 2008a, 2008b; 2014a, 2014b). Sammons and Anders (2015) have also compared the results of EPPSE with those from a major study in Germany (BiKS) and such comparative work provides further evidence of the role of preschool quality in different contexts. Many EPPSE papers (Sammons et al. 2004; 2008a, 2008b, 2008c; 2013; 2015) as well as the current paper focus exclusively on the quantitative findings. However, EPPSE used a mixed-methods design and important findings from the integration of qualitative and quantitative findings have been described elsewhere (Sammons et al. 2005; Siraj-Blatchford et al. 2006; Sylva 2014). In addition, readers are pointed to Siraj and Mayo (2014) for qualitative analysis of positive outliers, i.e., those children who 'succeed beyond the odds' with the support of parents and preschool staff working together. Rich details of supportive parenting are provided in Siraj and Mayo (2014), with qualitative description of the contribution of preschool to helping children thrive despite living in the midst of adversity.

Finally, and most importantly, this paper ends with a provocative proposal for a theoretical model in which self-regulation acts as a mediator at the start of school in the path between high quality early learning experiences and 21st century skills at the end of primary education. These pathways to age 11 have not yet been published on the EPPSE data. However, using multi-level structural equation modelling on the EPPSE dataset, Hall et al. (2009; 2013) showed high process quality acted as a 'protective factor' between the ages of 3 and 5 for children at risk for poor developmental outcomes at school entry. It is hypothesized in this paper that self-regulation at the age of 5 mediates the effects of high quality preschool experience on later 21st century outcomes (as well as academic ones). We believe that preschool quality supports the development of self- regulation at age 5, which in turn will

lead to better academic attainment and self-regulation at age 11, and eventually to higher attainment at secondary school (Sammons et al. 2015).

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Tables and Figures

Table 1: An emerging consensus in Europe on the curricular aims of ECEC (adapted from Sylva et al. 2016)

Developing a positive self-concept, and engagement in social relations	**Learning processes or 'soft skills'**	**Specific knowledge or 'hard' skills**
• confidence • collaboration • communication • emotional self-regulation	• critical thinking and reasoning • problem solving and planning • decision making • enthusiasm for learning • curiosity, imagination, creativity • perseverance • cognitive self-regulation	• rich content that helps children develop knowledge of the world, including their local environment • specific 'hard' skills, including *emerging academic skills such as numeracy and literacy*

Table 2: Child cognitive assessments at ages 3 (start of preschool) and 5+ (school entry)

Cognitive Pre-school Battery Ages 3 and 5	Assessment Content
Oral Language Skills	
BAS-II Verbal Comprehension	Receptive language: understanding of oral instructions involving basic language concepts.
BAS-II Naming Vocabulary	Expressive language; e.g. knowledge of object names.
Non-verbal Skills	
BAS-II Picture Similarities	Non-verbal reasoning shown by matching pictures that have a common element or concept.
Pattern Construction	Block-building or shape matching
Code related skills (age 5 only)	
Phonological Awareness	Two subscales on the detection of rhyme and alliteration: 3 words are presented at a time, and the child has to identify the odd one out (e.g. bun/hut/sun, or pin/dog/pig).
Letter Recognition	All English letters in upper and lower case

Table 3: Academic and 21st century outcomes at age 11

Assessment Battery Age 11	Assessment Content
National Academic Assessments Nationally devised and marked tests	English (reading, writing, spelling) Mathematics
Self-regulation Teacher completed rating scale	Individual items • Like to work things out for self; seeks help rarely • Does not need much help with tasks • Chooses activities on their own • Persists in the face of difficult tasks • Can move on to a new activity after finishing a task • Open and direct about what she/he wants • Confident with others • Shows leadership in group work • Can take responsibility for a task
Pro-social behavior Teacher completed rating scale	Individual items • Considerate of other people's feelings • Shares readily with other children (treats, toys, etc.) • Helpful if someone is hurt, upset or feeling ill • Kind to younger children • Often volunteers to help others (teachers, other children) • Offers to help others having difficulties with a task • Sympathetic to others if they are upset • Apologises spontaneously

Table 4: ECERS-R and ECERS-E sub-scales

ECERS-R Global Quality	**ECERS-E Domain-specific Quality observed in specific Curricular Areas**

• 7 sub-scales:
  • Space and furnishings
  • Personal care routines
  • Language reasoning
  • Activities
  • Interaction
  • Programme structure
  • Parents and staff
 	
(Harms, Clifford & Cryer,1998)
	• 4 sub-scales:
	  • Literacy
	  • Mathematics
	  • Science and environment
	  • Diversity
	
	(Sylva, Siraj-Blatchford & Taggart, 2010)

Table 5: Multilevel findings on the impact of process quality on cognitive and linguistic progress between the ages of 3 and 5 years
(Co-variates in the model: prior attainment at age 3, child, parent, home environment and other 'intake' measures)

		Code-related Skills	**Oral Language**	**Non-verbal reasoning**
ECERS_E	Total score	Positive $		positive
	Literacy	positive		
	Maths			positive
	Science / Environment			positive*
	Diversity	positive*		positive
ECERS_R	Total score			
	Space & Furnishings			
	Personal Care Routines			
	Language & Reasoning			
	Pre-school Activities			
	Social Interaction			
	Organization & Routine			
	Adults Working Together	positive*		

* verging on significance $ when change of centre is not included in model

Figure 1 The contribution of curriculum and quality to children's developmental outcomes (From Sylva et al, 2016)

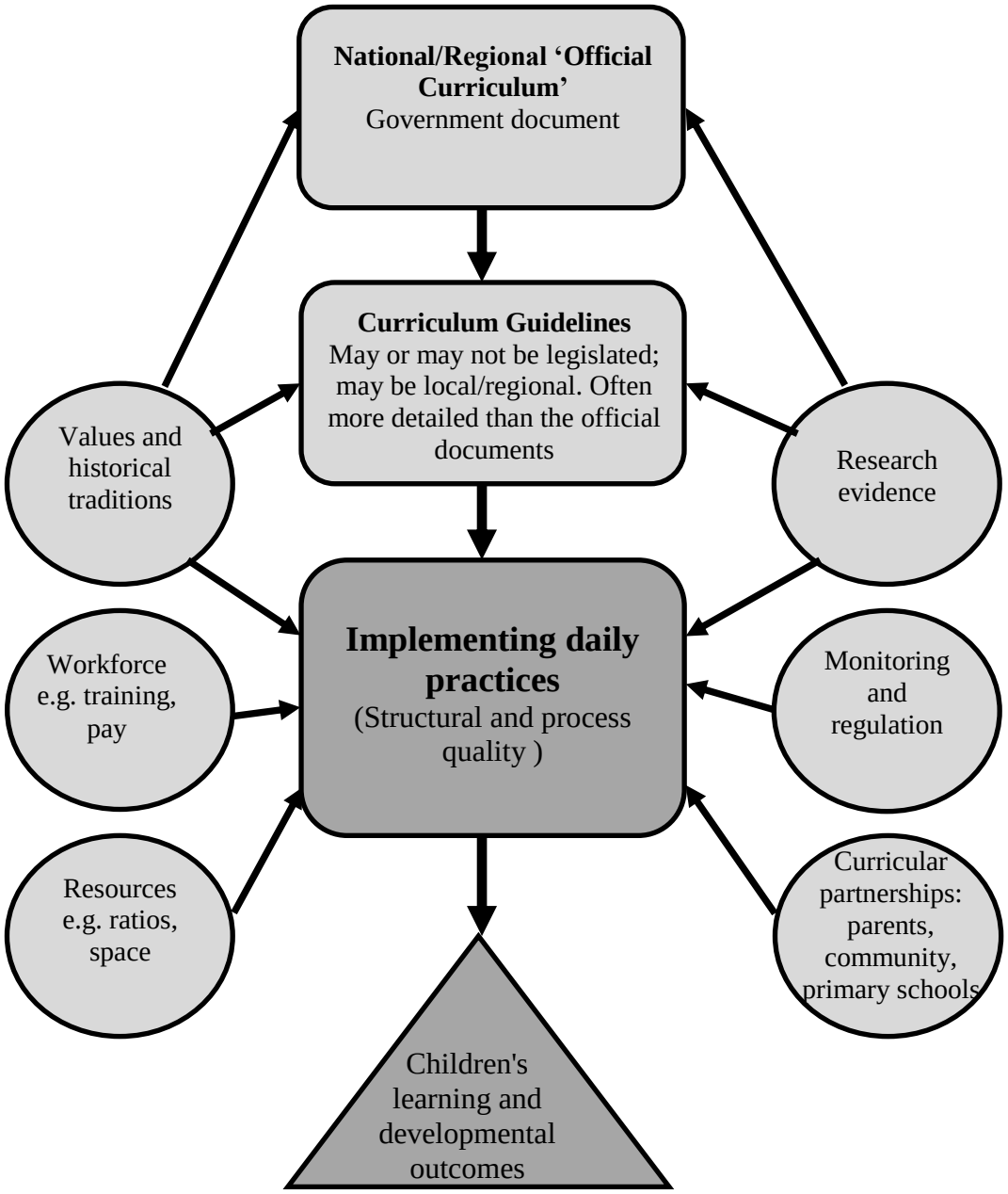

Figure 2: Effective Preschool, Primary and Secondary Education (EPPSE) design

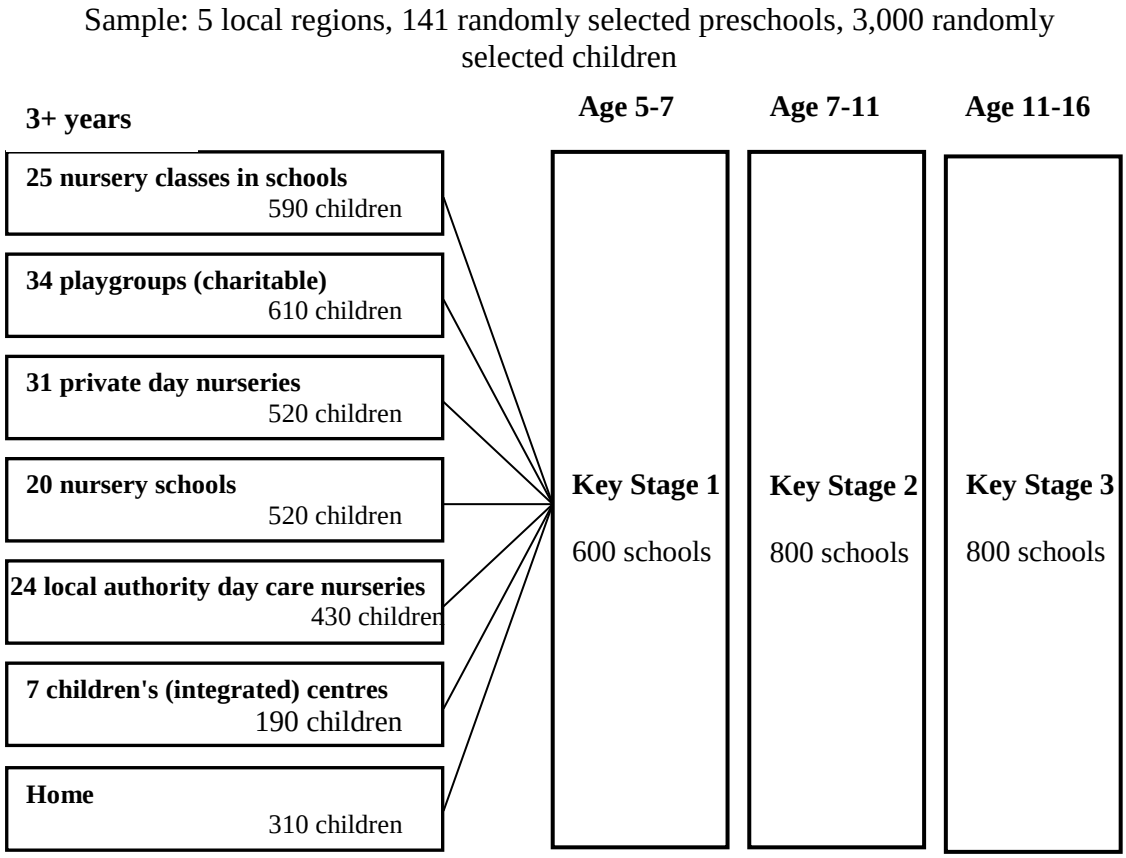

Figure 3: Net effect of pre-school duration and quality (ECERS-E) on code-related skills at age 5 after control for pre-test and other confounding factors

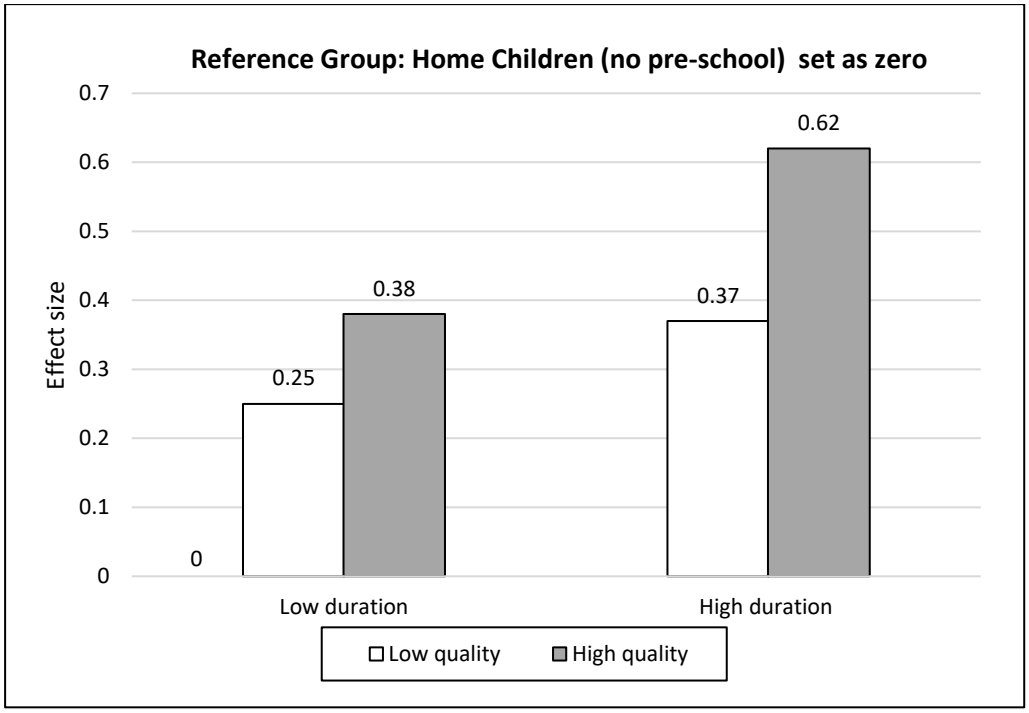

Figure 4: Net Effect of Pre-School Quality (ECERS-E) on English and Mathematics at Age 11, after controlling for co-variates

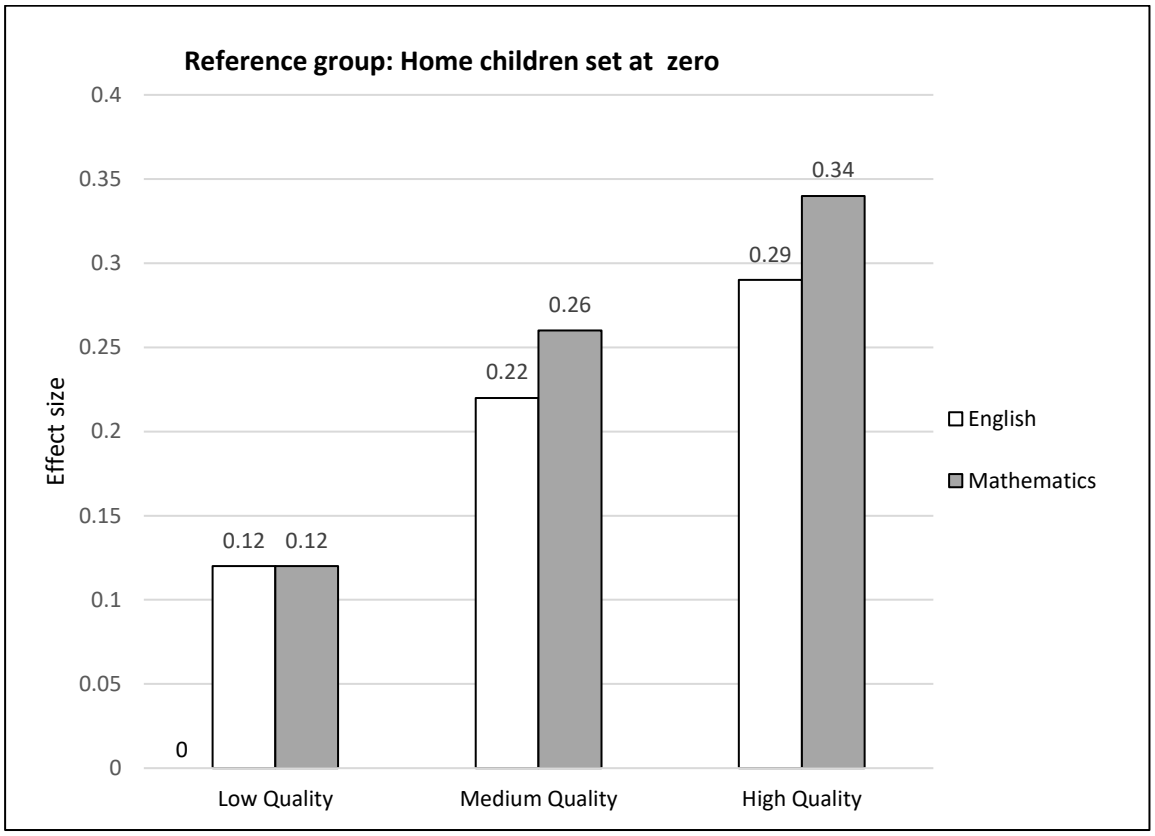

Figure 5: Net effect of pre-school quality (ECERS-R and ECERS-E) on self-regulation at age 11, after controlling for co-variates

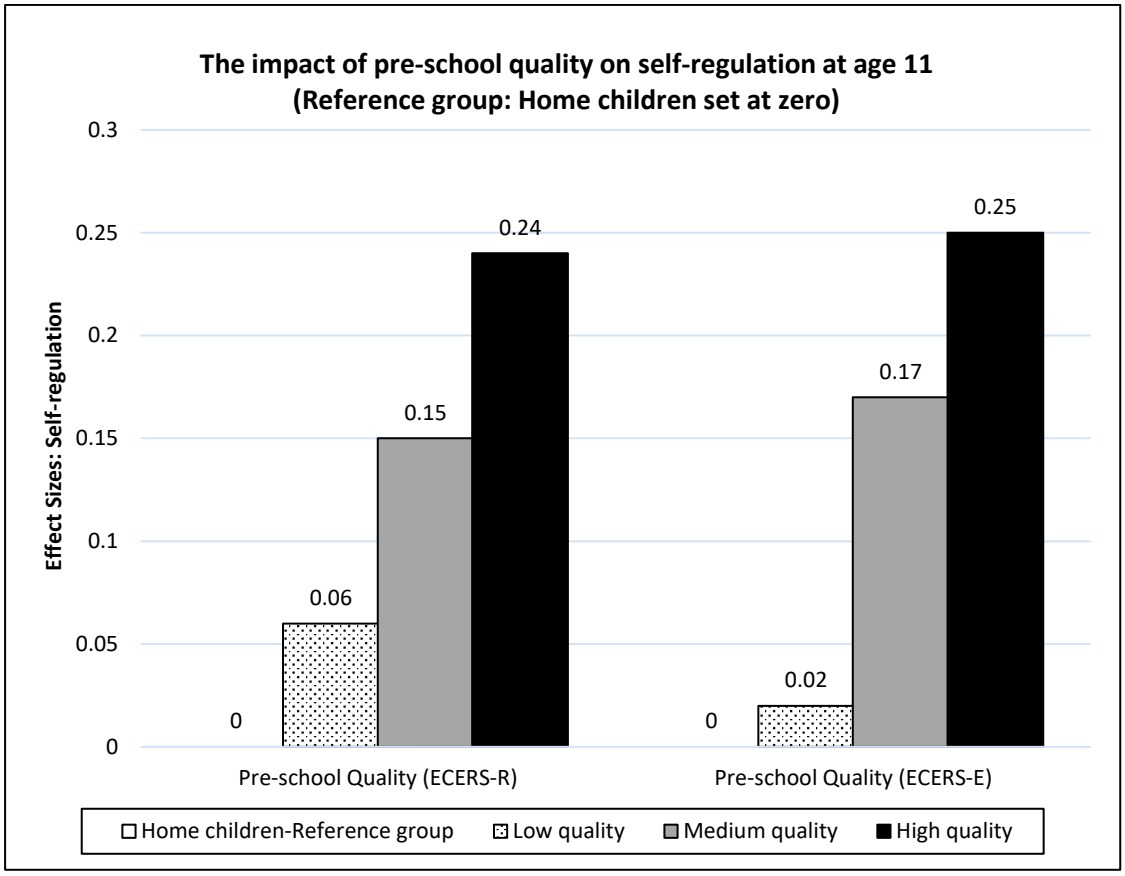

Figure 6: Net effect of pre-school quality (ECERS-R and ECERS-E) on pro-social behaviour at age 11 after controlling for co-variates

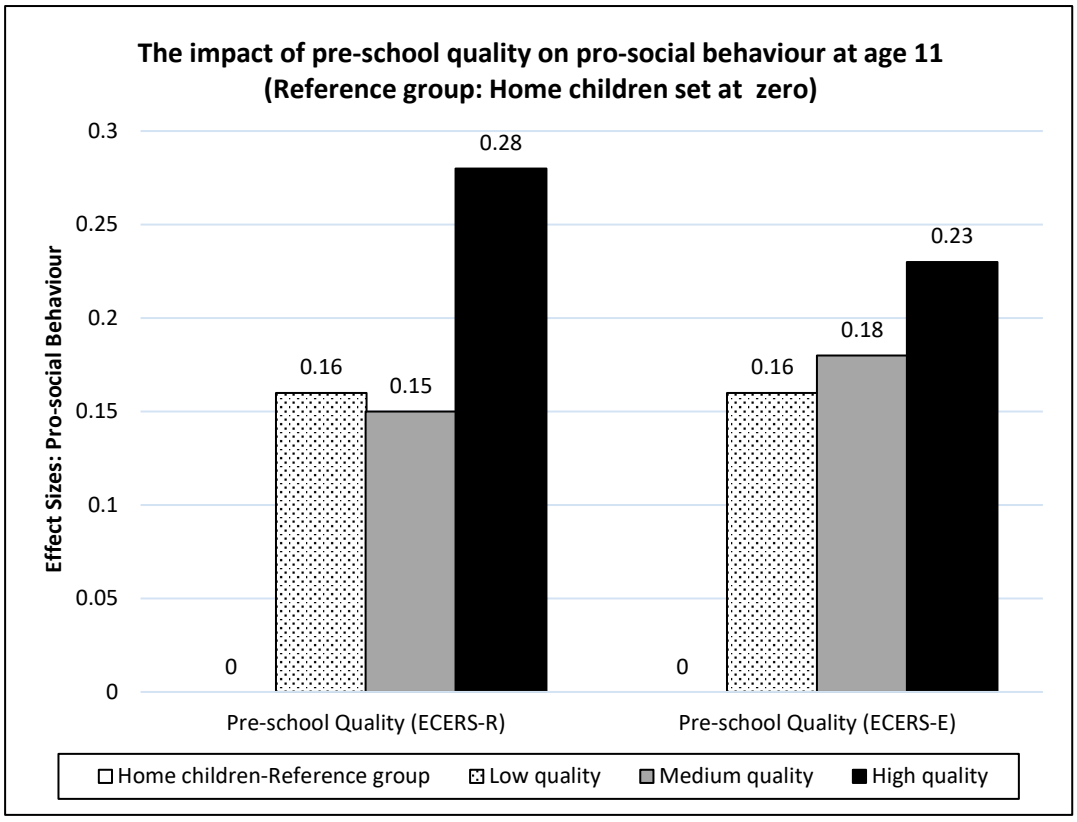

Figure 7: Hypothesised role of self-regulation at age 5 as a mediator in the effect of pre-school learning quality at home and pre-school on academic attainment and 21st century skills at age 11