Article

An Exploratory, Cluster Randomised Control Trial of the PAX Good Behaviour Game

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Abstract

This article presents the findings of an exploratory randomised controlled trial of the PAX Good Behaviour Game (PAX GBG) in Northern Ireland. The PAX GBG is an evidence-based universal prevention programme designed to improve mental health by increasing self-regulation, academic engagement, and decreasing disruptive behaviour in children. The study was designed in line with the Medical Research Council guidance on the development of complex interventions and is based on the Medical Research Council framework, more specifically within a Phase 2 exploratory trial. The study used a cluster randomised controlled trial design with a total of 15 schools (19 classes) randomised to intervention and control. This article reports specifically on the outcome of self-regulation with 355 elementary school pupils in year 3 (age M = 7.40, SD = 0.30). Participating schools in the trial were located in areas of socio-economic disadvantage. The teachers in the intervention group received training in the delivery of the PAX GBG and implemented the PAX GBG intervention for 12 weeks. A range of pre- and post-test measures, including child reported behaviours, were undertaken. After the 12 weeks of implementation, this exploratory trial provided some evidence that the PAX GBG may help improve self-regulation (d = .42) in participating pupils, while the findings suggest that it may offer a feasible mental health prevention and early intervention approach for Northern Ireland classrooms. However, a larger definitive trial would be needed to verify the findings in this study.

Keywords

elementary school; good behaviour game; mental health; primary school; self-regulation; students behaviour; universal prevention

1. Introduction

1.1. Child Mental Health

It is reported that ten to 20% of children experience mental health problems and half of all mental problems begin by the age of 14 (Kessler et al., 2005; WHO, 2018). A recent survey by the National Health Service (2017) on the mental health of children and young people in England reports that one in eight (12.8%) of five- to 19-year-olds had at least one mental disorder when assessed in 2017. The report also details that there has been a slight increase over time in the prevalence of mental disorders, rising from 9.7% in 1999 and 10.1% in 2004 to 11.2% in 2017. The report also notes that emotional disorders have become more common in five- to 15-year-olds, going from 4.3% in 1999 and 3.9% in 2004 to 5.8% in 2017 (National Health Service, 2017). Children's mental health problems are frequently linked to the increased likelihood of other problems in later life, such as poor

educational attainment, antisocial behaviour, drug and alcohol misuse and involvement in criminal activity (NICE, 2016). Mental health and behavioural problems have been identified as the primary drivers of disability and those affected are at a higher risk of attempting and completing suicide (Hawton et al., 2003; Lozano et al., 2012).

In Northern Ireland, poor mental health is the largest cause of ill health and disability, and the Public Health Agency has been keen to address this. According to the *Making Life Better Report* (Department of Health Northern Ireland, 2015), Northern Ireland has higher levels of mental ill health than any other region in the UK with one in five adults having a mental health condition, a 25% higher prevalence rate than England (Department of Education Northern Ireland—DHSSPS, 2015). Recent statistics for Northern Ireland have also shown that about 45,000 young people have a mental health problem and that >20% of young people suffer significant mental health problems by the time they reach 18 (Department of Education Northern Ireland—DHSSPS, 2015). The Young Life and Times Survey conducted in Northern Ireland suggested that the mental health of young people had deteriorated between 2008 and 2013 (ARK, 2014). The mental health of children and young people in Northern Ireland has become an increasing concern for families, schools, the Department of Education Northern Ireland (DENI), and policy makers (DENI, 2017). In 2015, 318 suicides were registered in Northern Ireland, the highest figure since records began in 1970 that also indicates that suicide rates in the most deprived areas of Northern Ireland are three times higher than in the least deprived (Torney, 2016). Young people from households in more deprived areas of Northern Ireland have a 14% higher percentage risk of serious personal emotional or mental health problems than those from better off households (Schubotz, 2010).

School prevention programmes are becoming an increasingly popular means through which to address problematic behaviours, many of which are effective and show positive results (Katz et al., 2013). As reported by Wells et al. (2003) in a systematic review of universal approaches to mental health promotion in schools, the importance of developing resilience and focusing on mental health promotion in schools can help with prevention of mental health issues in later life.

1.2. Mental Health: Prevention and Early intervention

It is widely recognised that prevention and early intervention is a key step in addressing mental health in children and young people. In 2015, the four UK Children's Commissioners recommended to the United Nations Committee on the Rights of the Child that there should be investment in universal preventative and early intervention children's services to prevent an increase in mental health problems among children (UK Children's Commissioners, 2015). It is reported that children and young people who develop good mental health are bet-

ter able to deal with emotional challenges now and in later life. They are also reported to recover more quickly from illness, and are less likely to engage in behaviours, which may put their health at risk (Chanfreau et al., 2008; Davies, 2012).

School-based prevention and early interventions are an increasingly common means through which educators, researchers, and policy makers are trying to address the issues of mental health in children and young people (Katz et al., 2013; Surgenor et al., 2016). A systematic review by Bonell et al., (2013) found that school-based interventions show the potential to improve young people's health particularly regarding violence, aggression and physical activity. Failure, however, to address problematic behaviours in childhood can have immediate and long-term effects on mental health. This may explain why many school-based interventions are designed to target problematic behaviour in the first instance, which is traditionally linked to mental health problems in adolescence and later life (Kellam et al., 2008, 2011).

Research frequently indicates positive links between self-regulation skills and pro-social behaviours (Buckner et al., 2009; Eisenberg, 2000; Hagger et al., 2009), with problematic behaviours and mental health in later life linked to children's ability to self-regulate their behaviour and emotions at a young age (Kellam et al., 2008). Research has shown, however, that 70% of young people who experience mental health problems do not have appropriate interventions at a sufficiently early age (4Children's Society, 2008). It would appear, therefore, that the classroom environment is an ideal place to address some of these issues, allowing children to acquire new skills and knowledge whilst learning to cooperate with their peers. In doing so, they may learn a range of social, emotional and behavioural skills that enable them to self-regulate, manage their thoughts, emotions and behaviours so that they can cope better with difficulties in later life (Durlak et al., 2011). One promising intervention is the PAX Good Behaviour Game (PAX GBG) on which we report here.

2. The PAX Good Behaviour Game

Interest in the GBG has led to a number of trials taking place within the UK and Ireland (Chan et al., 2012; Coombes et al., 2016; Humphrey et al., 2018; O'Donnell et al., 2016). Evidence from the USA, and more recently in international settings (Dijkman et al., 2015; Kellam et al., 2008; Leflot et al., 2013; Smith et al., 2018), has shown the GBG to be effective in preventing mental (cognitive), emotional and behavioural problems amongst children. The GBG was originally designed by a teacher, Muriel Saunders for her year 5 class (age 9–10) to address disruptive behaviour. This original version of the GBG was a simple invention where the pupils in a classroom were divided into teams, utilising peer competition and group rewards to reduce out-of-seat and talking-out behaviours (Barrish et al., 1969). More recent versions

of the GBG, such as the PAX version, focus on giving children the mental ability to sustain attention, self-regulate, cooperate with others intentionally, and create peace, productivity, health and happiness for self and others (PAXis Institute, 2015).

Research from randomised trials in the USA, Belgium, and the Netherlands has shown that the PAX GBG is effective in improving a wide range of public health and educational outcomes (Dijkman et al., 2015; Kellam et al., 2008; Leflot et al., 2013; Petras et al., 2008; Poduska et al., 2008; Smith et al., 2018; Wilcox et al., 2008). Studies have also shown that the PAX GBG is effective at targeting a range of behavioural issues when implemented with pupils aged 6–12 from grade one to six (Barrish et al., 1969; Harris & Sherman, 1973; Medland & Stachnik, 1972). The impact of PAX GBG is highest among pupils with higher initial levels of aggression (Petras et al., 2008), and studies amongst PAX GBG pupils have shown reductions in children's (particularly boys) externalising behaviour and improvements in positive peer relations when compared with control-group children (Jiang et al., 2018). These reductions in externalising behaviour appear to be partly mediated by the improvements in peer acceptance (Witvliet et al., 2009). Overall, the GBG in all formats has shown evidence of effectiveness in preventing childhood disruptive behaviours and promoting long-term health and well-being.

There are currently two manualised versions based on the original GBG, the American Institutes of Research (AIR) GBG and the PAX GBG. The PAX version of the GBG is primarily driven by the pupils who set out the rules of their classroom. The behaviours are referred to as "PAX" and "Spleems," and use gamification and fun learning to teach pupils self-regulation, self-control, and self-management in the context of collaborating with others. Things that pupils would like to happen more often in their classroom are called "PAX" (peace, productivity, health, and happiness) and things that they would like to happen less often are called "Spleems." Children quickly understand the difference between PAX behaviours and Spleems, an ability that is vital for learning sustainable self-regulation (PAXis Institute, 2015). The game is composed of a number of evidence-based "Kernels" (components or building blocks). These Kernels include games and rewards. The full details of the PAX GBG composition and rules used in this trial are published in the trial protocol (O'Keeffe et al., 2017).

3. Theory of Change

The theory of the intervention is illustrated in the logic model (Figure 1) by O'Keeffe et al. (2017). The primary aim of the PAX GBG is to increase self-regulation, which can lead to an improvement in behaviour, self-esteem, and peer relations. This is achieved by using rewards for good behaviour and positive reinforcement, encouraging the children to maintain attention and adhere to the classroom vision that they compiled and agreed with their teacher. The differentiating component of PAX GBG compared to other versions of the GBG is the focus on improving the self-regulation of participating pupils. Self-regulation is also referred to as self-control and self-discipline (Duckworth & Seligman, 2005), and implies an ability of the self to control or change responses in order to regulate behaviour, thoughts and emotions. Self-regulation also includes the ability to control impulses, to manage short-term desires and to make better choices by looking forward and delaying gratification (Ainslie, 1975; Mischel & Underwood, 1974; Zimmerman, 2001).

Rather than assuming that environmental factors are the critical determinants of learning and classroom management, the programme gives ownership of the learning process to the learner. Pupils who participate in PAX GBG are guided by their own suggestions on acceptable behaviour (the PAX vision chart) in relation to what they want to see, hear, do, and feel more or less of in their classroom (PAXis Institute, 2015). Through meta-cognition and self-regulation, the PAX GBG helps pupils to think about their own behaviour and the content of the classroom vision chart that they compile together. The cognitive processes of effort and monitoring of behaviours are driven by an interest in winning the PAX game for rewards, Granny's Wacky Prizes (GWP), and receiving positive reinforcement. These are intrinsic (intangible) rewards and recognition that reinforce a sense of achievement for the pupil. By winning a GWP, the pupil reflects on their individual and collective actions according to the vision chart, which reinforces the positive behaviour (PAXis Institute, 2015; Zimmerman, 2010).

In the PAX GBG, positive reinforcement and social interdependence support and promote co-operative learning and peer relationships. The PAX GBG uses rewards for good behaviour and positive reinforcement to encourage children to work cooperatively, maintain attention and comply with the classroom vision. The classroom vision is made up of all the acceptable and unacceptable behaviours that the pupils collectively compile and agree with their teacher. This collective process is underpinned by the theory of social interdependence (Johnson & Johnson, 2012; Johnson et al., 2010), which infers that when pupils work together cooperatively they work harder and develop positive relationships with their peers. This process helps pupils by promoting improved social and emotional wellbeing, such as mental health, self-esteem, the ability to manage stress and adversity (Johnson & Johnson, 1999). Pupils also develop the ability to self-regulate their own behaviours and work cooperatively as part of a team in a manner that is conducive to both them and the whole team. This repeated process, in the long term, has been shown to help improve behaviour and self-esteem in participating children.

The overall aim of this study was to use a randomised controlled trial design to explore the effectiveness of the PAX GBG programme within the context of
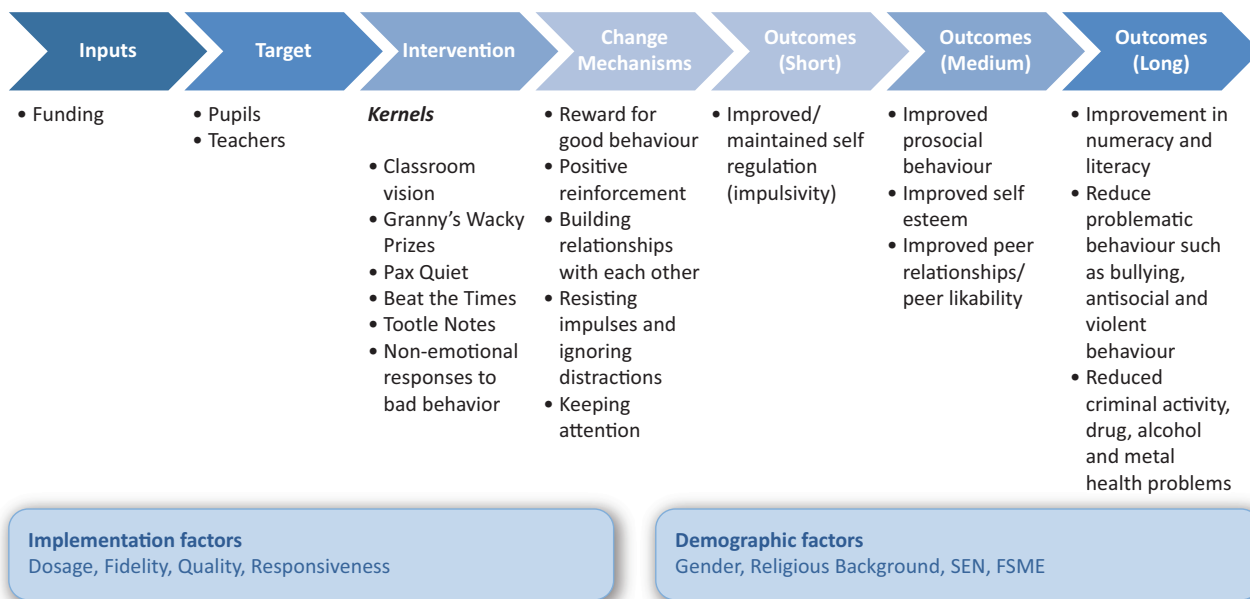
Inputs	Target	Intervention	Change Mechanisms	Outcomes (Short)	Outcomes (Medium)	Outcomes (Long)
• Funding	• Pupils • Teachers	**Kernels** • Classroom vision • Granny's Wacky Prizes • Pax Quiet • Beat the Times • Tootle Notes • Non-emotional responses to bad behavior	• Reward for good behaviour • Positive reinforcement • Building relationships with each other • Resisting impulses and ignoring distractions • Keeping attention	• Improved/ maintained self regulation (impulsivity)	• Improved prosocial behaviour • Improved self esteem • Improved peer relationships/ peer likability	• Improvement in numeracy and literacy • Reduce problematic behaviour such as bullying, antisocial and violent behaviour • Reduced criminal activity, drug, alcohol and metal health problems

Implementation factors
Dosage, Fidelity, Quality, Responsiveness

Demographic factors
Gender, Religious Background, SEN, FSME

Figure 1. Logic model for the PAX GBG intervention (O'Keeffe et al., 2017).

disadvantaged schools in Northern Ireland. This article looks specifically at the outcome of self-regulation.

4. Methods

4.1. Trial Design Summary

A research protocol outlining the proposed design for this trial was collated according to the SPIRIT (2015) guidelines and is published in the *International Journal of Educational Research* (O'Keeffe et al., 2017). This study was designed in-line with Medical Research Council guidelines on development of complex interventions, more specifically within a Phase 2 exploratory trial (Moore et al., 2015).

The schools recruited for the exploratory trial were randomised to one of two conditions: (a) implementation of the PAX GBG for 12 weeks and (b) continue with normal classroom activity (without PAX GBG implementation). The target population was Northern Irish year 3 elementary school children (age 6–8) living in disadvantaged areas within a 10-mile radius of Belfast city. The main aim was to measure any improvements, as a result of the intervention, on child reported self-regulation.

4.2. Intervention

Three of the authors of this article became PAXis Institute accredited trainers. The training was delivered by the PAXis Institute and lasted one week. The training was intensive and consisted of a mixture of theoretical and practical elements. The training covered the theoretical underpinnings, the game construct and main elements known as the Kernels and how the game works in practice. The training was led by a range of professionals, including the programme developer, Dr. Dennis Embry,

PAX partners, teachers, and staff from the PAXis institute. Teachers in the PAX GBG condition received training and were provided with a PAX GBG kit.

The training was condensed by drawing upon the key elements of the game Kernels that would be implemented as part of the trial. All the key information and instruction was extracted from the 139-page manual around the seven Kernels (PAX classroom vision, PAX language, PAX quiet, PAX game, GWP, transition games, tootle notes). A 2-day training schedule was designed and training slides were developed with sample videos of PAX GBG in action. The training had a logical sequence, taking the teachers through the programme step by step. Day one consisted of background, theory behind the programme, and all the Kernels. Day two focused on ensuring that the teacher fully understood the programme and how to implement it once they returned to the classroom. This involved practical sessions, a short test to ensure they fully understood the main concepts of the programme, and a question-and-answer session with the trainers.

The PAX GBG was played three times per day starting at 10 minutes, stretching to 40 minutes over the 12-week period, as the children's self-regulation and behaviour improved. A classroom playing the PAX GBG typically has three to five PAX teams at any given time. The PAX GBG encourages pupils to work through the existing curriculum co-operatively and efficiently. It promotes rules of pro-social behaviour and peer concern for classmates by rewarding teams for maintaining behaviour standards (Chan et al., 2012). The teacher can generate the teams either randomly or deliberately, depending on the context of the game. The teams can be given identity in a number of ways by, for example, the use of coloured armbands, fun names or simply by seating location. The teams should be balanced to ensure that all children

are represented as well as possible. Every team can win if it has three or fewer Spleems during a PAX GBG of a defined duration. The teacher, an adult or a designated class PAX leader can record the Spleems (PAXis Institute, 2015). A TiDier checklist table (Hoffmann et al., 2014; O'Keeffe et al., 2017) outlining all the elements of the PAX GBG programme implementation is shown in Figure A1 of the Supplementary File.

5. Recruitment and Randomisation

5.1. Recruitment

A list of elementary schools was obtained from the DENI. School selection was based on the percentage of children entitled to free school meals (FSME) defined by DENI statistics. The Belfast area was identified as having the highest percentage of elementary school children receiving FSME, 57.4% in comparison to a national average of 29.2% across the rest of Northern Ireland. The elementary schools in the sample were targeted to ensure recruitment from schools with a minimum class size of 15, a minimum enrolment of 140 for the year group undertaking the intervention, higher than 47% FSME, and within a 10-mile radius of Belfast city centre. A total of 56 schools met the inclusion criteria and were contacted for the main trial. Nineteen schools were recruited after invitation to the trial (enrolment range between 143 to 635 and a FSME of 49.77% to 86.26%). Consent was obtained from all of the participants involved in this PAX GBG trial. Teachers and principals gave consent through consent forms issued at the recruitment stage. Consent forms were sent out by the school to the parents/guardians and consisted of an "opt out" format. This trial was approved by the Ethics Committee in the School of Social Sciences Education and Social Work at Queen's University Belfast prior to any contact with schools or pupils.

5.2. Sample

A total of 424 year 3 children aged between six and eight years took part in the trial. The pupils were drawn from 24 year 3 classes spread across 19 schools. Two schools dropped out before the trial began and pre-testing took place (one control school and one intervention school). Two schools dropped out after allocation to condition (one from each arm of the trial). This left a sample of 15 schools and 19 year 3 classes, with n = 355 and these are included in the final intention to treat analysis. In the final sample there were no significant differences between the intervention and control groups on the basis of school size (t (13) = −0.37, p = .72) or FSME (t (13) = 0.10, p = .92). Table 1 summarises school size, class size, and FSME of control and intervention group in the final sample. The sample, attrition and experimental processes are summarised in accordance with the CONSORT guidelines (see Figure A2 of the Supplementary File; Schulz et al., 2010).

The mean Northern Ireland Multiple Deprivation Measure (NIMDM) scores for both control and intervention were similar {M_c = 4.50 (SD = 0.84) and M_i = 4.54, (SD = 0.96)}. The intervention and control groups were also comparable in terms of the deprivation scores of the children's place of residence (Table 2).

The breakdown of the sample by gender, special educational needs (SEN), ethnicity, English as an additional language (EAL), and the NIMDM average is summarised in Table 3. The pupil (n) refers to the number of pupils who sat the pre- and post-test. There are notable differences between the groups in terms of the numbers dropping out prior to pretesting. Gender balance is similar in both groups. The control group had a slightly higher percentage of children from ethnicities other than white, a slightly higher percentage of children with EAL (8%) and a slightly larger percentage of Asian (1.3%) and other ethnicity (1.9%) compared to the intervention.

Table 1. Sample summary.

	Control	Intervention
Number of Schools (N)	7	8
Number of classes (n)	8	11
	Mean (SD)	Mean (SD)
School size	320 (119)	*361* (182)
Class size	21 (4.66)	24 (2.91)
FSME	67.5 (.011)	61 (0.09)

Table 2. Mean NIMDM.

	Control		Intervention	
n	Mean (standard deviation)	*n*	Mean (standard deviation)
242	4.50 (0.84)	162	4.54 (0.96)

Table 3. Sample characteristics.

Characteristic	Group			
	Intervention group		Control group	
	n	%	n	%
Total number of pupils	268	63.2	156	36.8
Gender				
Female	139	51.9	83	53.2
Male	128	48.1	73	46.8
SEN				
Yes	86	32	44	27
No	183	68	97	59.5
Not specified			22	13.50
Ethnicity				
White	263	97.8	145	93.5
Mixed/multiple ethnic groups	3	1.1	2	1.3
Asian/Asian British	0	0	2	1.3
Black/African/Caribbean/Black British	3	1.1	3	1.9
Other ethnic group	0	0	3	1.9
EAL				
Yes	4	1.5	13	8
No	265	98.5	150	92

5.3. Randomisation

Randomisation took place at the school level. Randomisation was undertaken using both "blocking" and "minimisation" to minimize Type I error (Stolberg et al., 2004). Assignment to condition used minimisation to achieve a close balance of single/double form entry. After first rank ordering the schools in order of FSME and school size, their ranks were then block minimised to ensure an even distribution of sectors and disadvantage based on percentage FSME. They were then assigned to condition using true randomisation within these groups.

5.4. Sample Size Calculation

The estimation of power for the PAX GBG was provided by Optimal Design software. To detect a standardised effect size of 0.41, with 80% power, assuming alpha 0.05 and ICC of 0.07 (and with J = 20 clusters and average class size n = 25) required 500 subjects across the two arms. The effect size of +0.41 was used to model power and sample size. This effect size was used as previous effects sizes ranged from 0.12 to 0.57 (O'Donnell et al., 2016) and 0.56 to 0.83 (Ghaderi et al., 2017) for measures of pupil behaviours. A conservative estimate of 0.41 appeared to be reasonable to ensure analyses were not left underpowered. The ICC is in line with similar programmes such as Family Skills (Hussain et al., 2017), which have shown ICCs of between 0.02 and 0.15. The calculation also allows for a 5% attrition level at the individual or cluster level, and still being able to detect an effect size of +0.41.

5.5. Measures

The primary outcome of the trial was self-regulation, which corresponds to the logic model of the programme (O'Keeffe et al., 2017). The primary outcome measure chosen was the child self-control rating scale (Rorhbeck et al., 1991), which was selected on the basis that it was relatively short, well-validated, and designed to assess how well children self-regulate. The 33-item scale was modelled on the teacher and parent self-control rating scale (Kendall & Wilcox, 1979), and previous studies have indicated good reliability with a Cronbach's Alpha (α = 0.9). It uses a 5-point Likert scale, which ranges from *not at all like me* to *a lot like me*. The questionnaires were compiled online using a custom design that was user friendly for young children and the data collection was collected using iPads, with this method tested in a small feasibility study prior to commencing this exploratory trial. All pupils in both the intervention and control groups were tested in their classroom one week prior to teacher training and were tested again just one week after the intervention finished. The children gave their consent for participation before data collection began.

5.6. Implementation Fidelity

A thorough process evaluation was conducted for this exploratory trial to measure the fidelity of delivery and acceptability of the programme, following the Medical Research Council framework (Moore et al., 2015) and the relevant CONSORT statement (Moher et al., 2001). More

details of the process evaluation plan are available in the trial protocol (O'Keeffe et al., 2017).

6. Analysis

The statistical analysis was guided by the intervention logic model, as previously outlined in the trial protocol, (O'Keeffe et al., 2017). Data were captured via Lime Survey and transferred to STATA 15. The raw data were anonymised using an assigned unique ID. Internal reliability was assessed using Cronbach's alpha (α = 0.92), which is in line with that found in previous studies. The main analysis was based on complete cases (children deleted from analysis if they had missing pre or post-test scores). The missing data per variable lay between 0.6 and 26.8%. In subsidiary analysis, as per Rubin's (1976) framework, we assumed data to be missing at random, and used Multiple Imputation by Chained Equations (MICE) to conduct a sensitivity analysis. The NIMDM (NISRA, 2015) was calculated using each child's postcode via the Northern Ireland Statistics and Research Agency area profiles. The measure is ranked from 1 (*most deprived*) to 5022 (*least deprived*).

Descriptive statistics {means (SD); medians (IQR)} were generated for each outcome and any changes in the intervention group receiving the 12-week GBG programme was compared to the control group using pre- and post-test measures. Initial effects of the PAX GBG implementation on the outcomes were analysed on an-intention-to-treat basis. We also examined the effect of clustering on the outcomes.

The difference between mean scores for the intervention and control were tested using hierarchical linear modelling (HLM). HLM was used to account for clustering effects in the data. The main effects of clustering were determined to be at the school level and so two-level model was used to take account of clustering. HLM used the post-test score (dependent variable) with group assignment and the related pre-test scores as independent variables. HLM analysis was also used to control for in the data. The effect sizes (Cohen's *d*) were calculated using the Campbell effect size calculator (Wilson, n.d.) using the standardised mean difference, the unstandardised regression coefficient (B) from intervention group and the standard deviation (SD) of the pre-test whole group.

7. Results

7.1. Intervention Effects on Self-Regulation

An independent sample t-test based on complete cases was used for initial exploration of pre- to post-test change in each of the means of the primary outcome scales. This analysis was exploratory on the main outcome only, and a fuller analysis of data taking account of interaction of variables follows. The results provided some evidence of effectiveness through maintenance of self-regulation during the 12-week period, in that there was a decline in self-regulation in the control group and no change in the intervention group, as shown in Table 4.

In an HLM model (Tables 5, 6, and 7), the adjusted post-test to pre-test differences were compared between the control and intervention groups controlling for clustering on the self-regulation outcomes within schools. The developed model is presented across these tables showing how school (cluster) and individual effects were taken into account in the final models presented in Table 8.

After determining that there was a clustering effect to explore, HLM was undertaken, with and without multiple imputation, to assess the effects of missing data on outcomes. The effect sizes of the resultant model are presented both with, and without, multiple imputation for missing data in Table 6. The observed data model (β = .2, 95% CI .206 to .642; *d* = .42) and the model

Table 4. T test.

Outcome	Control or Intervention	N	Mean	SD	SE	t	df	Sig.
Pre test self-regulation	Intervention	224	4.02	0.713	0.048	3.05	256.333	0.003
	Control	131	3.76	0.768	0.067			
Post test self-regulation	Intervention	224	4.02	0.673	0.045	3.94	233.017	< .001
	Control	131	3.69	0.814	0.071			

Table 5. HLM model of self-regulation.

Source	SS	df	MS	
Model	58.17	2	29.08	Number of observations = 355
				F(2, 352) = 74.21
Residual	137.95	352	0.39	Prof > F > 0.0001
				R-squared = 0.30
Total	196.12	354	0.55	Adjusted R-squared = 0.29
				Root MSE = 0.626

Table 6. HLM main effects model for pre-post changes test on self-regulation.

Post-self-regulation	Coef.	Standard error	t	P > t	95% CI	
Main effects	0.20	0.07	2.93	0.004	0.07	0.34
Pre-self-regulation	0.51	0.05	11.19	> 0.001	0.42	0.60
Constant	1.178	0.18	9.90	> 0.001	1.42	2.13

Table 7. ANOVA showing between school clustering effects on self-regulation.

Source	SS	df	MS	F	Prob > F
Between school	22.04	14	1,57	2.95	0.0003
Within school	193.17	362	0.53		
Total	215,21	376	0.57		

Estimated SD of school effects = 0.20
Estimated SD individual effects = 0.73

generated with multiply imputed data (β = .2, 95% CI .009 to .40; d = .42), both indicate that self-regulation may have improved as a result of the intervention. The similarity in the outcomes and effects sizes from the observed and imputed models, indicated that missing data was not having a substantive effect on findings.

The ICC for this sample is 0.01, which is considered low in comparison to similar programmes such as Roots of Empathy (Connolly et al., 2018). An ICC of less than 0.40 indicates poor intra-class correlation (how strongly units in the same group resemble each other; see Cicchetti, 1994).

8. Discussion

In summary, this exploratory trial provided some evidence that the PAX GBG helped improve self-regulation in participating pupils. This trial is, to date, the only randomized controlled trial (RCT) of the PAX GBG to be conducted in Northern Ireland and Ireland. Although a recent large scale RCT took place in the UK of the AIR version of the GBG, it measured mainly reading improvement and behaviour. This trial looked specifically at the PAX GBG, which uses age specific, non-material, fun rewards that are cost effective and sustainable in the long-term. The PAX version of the GBG claims to go beyond the traditional conceptions of behaviour modification, with the main outcome of improved self-regulation.

Informed by the logic model outlined by O'Keeffe et al. (2017), this trial was designed to explore the effect of the PAX GBG at post-test and at the end of the programme on the primary outcome of self-regulation. A number of secondary outcomes including cooperative learning, self-esteem and behaviour were also assessed but are not reported in this article. The trial also explored whether the PAX GBG had a differential impact on pupils depending on their gender and their EAL, SEN, and socio-economic status.

The use of the pupil driven PAX vision chart may have encouraged the pupils to think about their own behaviours in the classroom through meta-cognition. The PAX GBG encouraged pupils to reinforce each other for group success in the game, driven by an interest in winning the PAX game rewards (GWPs) and receiving positive reinforcement. Pupils interact together and, in doing so, improve social skills and competencies and promote each other's success (Johnson et al., 2010; Roseth et al., 2008). This in turn would have enhanced their sense of self-satisfaction and motivation to continue to improve and regulate their behaviour (PAXis Institute, 2015; Zimmerman, 2010). The improvement in self-regulation may be attributed to the start-stop cognitive processes or the intrinsically reinforcing GWPs. The rewards for individual and collective efforts may have encouraged the pupils' desire to learn more self-regulation (Embry, 2016; PAXis Institute, 2015). The fun factor may also have contributed to the detected improvement in self-regulation; the quirky elements of these Kernels, such as the GWPs, PAX quiet, and Beat the Timer, are considered to be the key elements in

Table 8. Summary of effect sizes on observed and MI data (cluster control).

Outcome			Observed					MI				
	Sample size		β	p	CI	CI	d	β	p	CI	CI	d
	Intervention	Control	Regression Co-Eff				ES	Regression Co-Eff				ES
Self-regulation	224	131	0.20	**0.04**	**0.206**	**0.642**	**0.42**	0.20	**0.04**	**0.009**	**0.40**	**0.42**

this programme (Embry, 2004; Embry & Biglan, 2008). The evidence-based Kernels in the PAX GBG may have driven the change mechanisms as shown previously in Figure 1. The effect size detected for self-regulation may also be explained by the team-working and cooperative learning element of the PAX GBG. As noted previously, pupils have the opportunity to play and cooperate with their peers whilst practicing goal-directed behaviour, all of which are fundamental to the development of self-regulation (Vohs & Baumeister, 2011; Vygotsky, 1978).

The findings from this trial are reflective of those outlined in a recent systematic review and meta-analysis of 49 randomised clinical trials, evaluating 50 self-regulation interventions (Pandey et al., 2018) which concluded that interventions such as the PAX GBG are effective in children and young people. Academic achievement, mental health, behavioural improvements are reported as some of the main outcomes of self-regulation interventions.

It is worth noting that in an exploratory analysis, there was some evidence that gender, SEN, EAL and socio-economic status predicted post-test score for self-regulation when accounting for pre-test score. However, given the small sample size and small numbers within these subgroups, the interaction effects must be treated with caution. In addition, given the large number of tests undertaken in relation to exploring interaction effects, this may have increased the likelihood of a type I error (false positive). The findings are only exploratory, with the aim of identifying any patterns of interest that may be useful to consider in a larger phase 3 definitive trial.

The findings of this exploratory trial of the PAX GBG in Northern Ireland appear to have met the success criteria by partially supporting the first (proximal) step in the logic model, that is, the improvement of self-regulation in the short term compared to those in the control group. This may serve as a promising indication for subsequent steps for a phase 3 definitive trial.

9. Limitations

There were a number of limitations to this study, the first of which is that the researcher in this trial was also the trainer and evaluator. This may have introduced some unconscious bias into the study. Ideally, if a future phase 3 definitive trial was to be conducted then these responsibilities should be separated.

Missing data were also an issue and the reason for missing data was due to some of the teachers not filling in the pre-test questionnaires on time. The post-test child questionnaires were completed in the last two weeks of June and some children were absent from the classroom. Teachers noted that some families were taking holidays before the peak holiday period, which would explain some of the missing data from children at post-test. To overcome this, MICE was used for imputation and analysis was conducted on both imputed and observed sets. In future studies, consideration should be given to the time of year when testing in the classroom, as this would help avoid the times when pupils are more likely to be absent. In addition, a future trial of the PAX GBG would benefit from recruiting a larger number of schools, with over recruitment to allow for attrition.

A key limitation is that the trial only lasted 12 weeks between pre- and post-test, which is a very short time to fully implement such a substantial programme. As per the logic model, the evidence-based Kernels of the game aimed to develop pupils' ability to self-regulate their behaviours and work as part of a team. It was suggested that this repeated process, in time, would help improve behaviour and self-esteem in participating pupils. Future studies of the PAX GBG would benefit from a longer implementation period of two years such as that in the AIR GBG study by Humphrey et al. (2018).

10. Conclusion

This exploratory RCT assessed the PAX GBG as a potential early intervention for children in Northern Ireland classrooms to prevent mental ill health, in particular among those living in areas of high socio-economic disadvantage. The main aim of this study was to explore the effect of the PAX GBG on self-regulation among year 3 elementary school children. The study used a cluster randomised controlled trial design with a total of 15 schools (19 classes) randomised to intervention and control. The main aim of the data analysis was to explore the effect of the PAX GBG on the outcomes and produce an estimate of an effect size for a larger phase 3 definitive trial.

The PAX GBG did show promise and actually improved the first step (proximal) outcome (self-regulation) in the theory of change model for participating pupils. This study looked primarily at the short-term effect of the PAX GBG. However, there is a recognised link between self-regulation and mental health in later life. The ability to strengthen self-regulation may also be important for longer-term outcomes such as suicide prevention in later life (Brüdern et al., 2016; Gottfredson & Hirschi, 1990).

Many of the GBG studies have originated in the USA and have focused mainly on children's aggressive behaviour at school and were conducted with pupils from low income, urban areas that were predominantly African American. In contrast the studies in Europe with Dutch and Belgian children took place with predominately children from middle- to high-socio-economic backgrounds. However, it would appear that previously reported gains in these studies can be replicated in high poverty schools in Northern Ireland (Dijkman et al., 2015; Leflot et al., 2013; Werthamer-Larsson et al., 1991).

A larger scale trial would be beneficial to further investigate the modest effects that emerged from this trial and, indeed, to further explore the medium-term outcomes of the theoretical model as outlined by O'Keeffe et al. (2017). It is hoped that the findings in

this study will contribute to the existing literature on the PAX GBG and offer a basis on which to conduct a phase 3 definitive trial of the PAX GBG in Northern Ireland. In doing so, it may make a positive contribution to the health and wellbeing of children and young people by helping to improve self-regulation in the short term, and mental health in later life.

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Conflict of Interests

The authors declare that they have no conflict of interests.

Supplementary Material

Supplementary material for this article is available online in the format provided by the author (unedited).

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