Evaluation report for the desk cycle pilot

Helen Moors

Crescent Academy

February 2019

About IEE Innovation Evaluation Grants

The first four IEE Innovation Evaluation Grants were awarded in February 2017. Funded by the Institute for Effective Education (IEE), these grants supported pilot evaluations of innovations of teaching and learning approaches based on the Research Schools Network's goal of improving the attainment of pupils by increasing the use of evidence-based practices.

Since then a further 26 projects have been successful in their application for an IEE Innovation Evaluation Grant, bringing the total number to 30. The applications we received included a wide range of interesting, school-led innovations – from after-school film clubs to improve the creative writing of Year 5 pupils, to the use of audio feedback with Year 12 pupils – and we were really impressed with the thought that applicants had put into how these innovations could be evaluated.

The evaluations are small-scale, and test the kinds of innovations that schools are interested in. This is very much a "bottom-up" exercise, allowing schools to get some indicative evidence behind real-world initiatives. Many evaluations are now coming to an end, and we are starting to publish reports on the findings. It is important remember that these are small-scale projects, often carried out in one school, so it is not possible to generalise their findings. In fact, the main benefit of the Innovation Evaluation projects may be in the process, rather than the findings.

Contents

Executive summary

Description of the innovation

All children in the intervention groups were given access to a desk cycle during maths lessons. A desk cycle is a small, portable pedal unit which fits under a desk allowing a person to pedal whilst doing work. The units work on a magnetic resistance so are quiet. The children were able to decide for themselves how they used the cycles (ie, constant pedaling, or pedaling for only part of a lesson). The intervention lasted 15 weeks, starting at the end of January 2018 and continuing until May half-term. The main objective of the evaluation was to investigate whether teacher reports of children's hyperactivity changed in any way as a result of using the desk cycle. Of additional interest was whether there were any changes in the fitness levels of the children, or their attainment in maths.

Summary of the evaluation

Four schools in Stoke-on-Trent participated in the evaluation. The 2015 Index of Multiple Deprivation ranks Stoke-on-Trent as the thirteenth most deprived Local Authority in England, and all four schools are located in areas of high social deprivation.

The study involved 99 children from Year 6 and Year 5 classes. The children in each class with the highest hyperactivity scores were selected to be in the sample and classes were chosen at random to be intervention group or control group classes.

The measurements used were the hyperactivity scale of the Strength and Difficulties Questionnaire (SDQ), waist-to-height ratio, the time to complete the daily mile, and scores for the 2017 Year 6 SATs arithmetic paper or the Year 5 Maths Hub arithmetic paper, depending on the age of the child.

Summary of findings

Overall, the study showed positive effect sizes for waist-to-height ratio (+0.15), time to complete the daily mile (+0.11) and SDQ hyperactivity scale (+0.93). Pupils in the intervention group had a median reduction of two points on the 10-point teacher-reported hyperactivity scale in contrast to a median reduction in score of 0 for the control group pupils. However there were negative effect sizes for maths progress in both Year 6 (-0.52) and Year 5 (-0.16).

Limitations of the study include the small sample size of 99 children, difficulty reliably determining how far the children had cycled, and lack of prior research in this area (meaning a literature review proved to be very difficult). The 15-week trial period was also quite short so a longer study is required to produce more reliable data.

Introduction

Description of the problem

Children can spend up to 70% of their time sitting down at school (Hinckson et al, 2016). From a health point of view this is very worrying, particularly in Stoke-on-Trent where health indices are well below the national average (Public Health England). Hegarty et al (2016) reported that 'Prolonged, uninterrupted periods of sedentary time may be associated with increased risk of Type II diabetes, cardiovascular disease and all-cause mortality even if the minimum recommended levels of daily physical activity are achieved. It is reported that children spend approximately 80% of their day engaged in sedentary behaviours' (p 520). There is also a proven link between exercise and fitness levels and attainment; and again the attainment of children in Stoke-on-Trent is below the national average (Public Health Report, Child Profile 2016). Some children find it difficult to remain sedentary in a classroom for any length of time. Teachers comment that these children lose focus and concentration and take longer to complete tasks. They also have an inclination to disturb other children as they can unintentionally make annoying noises by tapping or constantly moving in their chair. These children are not naughty children, they just do not cope well with long periods of inactivity.

Review of existing research

Research evidence supports the view that an increase in physical activity has a positive effect on cognitive development and consequently attainment. Some of the newest of these discoveries are the immediate effects of exercise on the mind. Studies have shown that, after freshly completing a session of exercise, people are better able to concentrate and ignore distractions (Drollette et. al, 2013). Exercise has also been shown to improve pupil memory, significantly improving both short- and long-term verbal memory (Etnier et. al, 2014). A report published in 2017 in *Sports Medicine Australia* concluded that 'Positive effects were found for physical activity on executive functions, attention and academic performance in preadolescent children. Largest effects are expected for interventions that aim for continuous regular physical activity over several weeks.' (de Greeff et al, 2017, p. 501). In America kinaesthetic learning in the classroom (not to be confused with Kinaesthetic learning style) is being evaluated. This approach is a subset of active learning, as children in this case are being physically active and moving round in the classroom as they learn; in a small number of schools they are using desk cycles. An elementary school in America trialled the use of desk cycles and reports state that the outcome was positive (Eyewitness News, 2016). The children's reading improved and pupils reported that using the desk cycles helped them concentrate and helped reduce stress levels. In addition data from a Read and Ride programme being run in over 30 schools in the US show a link between the use of an exercise bike with a growth in literacy scores and reading comprehension**.** It should be acknowledged though that there doesn't appear to be a control group in any of the American studies and no research data is publicly available.

Description of the innovation

The participating children in each of the six intervention classes (50 children in total) were given access to a desk cycle during maths lessons. The children were able to choose how and when they used the cycles in the lesson. The participating children in each of the six control classes (49 children in total) did not have access to a desk cycle at any time.

Research questions

Research question 1. Does access to desk cycles in a primary school classroom setting for 15 weeks reduce the hyperactivity levels of Year 5 and 6 pupils with high levels of hyperactivity?

Research question 2. Does access to desk cycles in a primary school classroom setting for 15 weeks improve the attainment in maths of Year 5 and 6 pupils with high levels of hyperactivity?

Research question 3. Does access to desk cycles in a primary school classroom setting for 15 weeks have a positive impact on the fitness levels of Year 5 and 6 pupils with high levels of hyperactivity?

Method

Sample

The four schools involved in the study are located in Stoke-on-Trent. Two of the schools are in the north of the city and two are in the south; all are in urban settings. The percentage of children in each school who speak English as an additional language can be seen below (compared to the national average for primary schools of 20.8%):

- Moorpark Junior School 19.1%
- Crescent Academy 7.8%
- STAR Academy 8%
- Sandford Hill Primary 9.2%

The percentage of children eligible to receive free school meals in the last six years at each school can be seen below (national average for primary schools, 24.9%):

- Moorpark Junior School 47.9%
- Crescent Academy 58%
- STAR Academy 39.3%
- Sandford Hill Primary 22.2%

The progress scores for each school in reading, writing and maths are shown in Table 1. Data has been taken from https://www.compare-school-performance.service.gov.uk and indicates the amount of progress pupils made between the end of Key Stage 1 and the end of Key Stage 2 compared to pupils across England with similar attainment at the end of Key Stage 1.

TABLE 1

School	Reading	Writing	Maths
Moorpark Junior School	Below average	Above Average	Average
Crescent Academy	Average	Above Average	Above Average
STAR Academy	Average	Average	Average
Sandford Hill	Average	Average	Above Average

Class teachers completed the Strengths and Difficulties Questionnaire (SDQ) for all pupils in their class. In each class the pupils with the 10 highest scores on the hyperactivity scale formed the sample, provided they scored four or above on the hyperactivity scale of the SDQ. In intervention group classes where less than 10 pupils had a pre-test score of four or above, the 10 pupils with the highest scores had access to a desk cycle (to ensure consistency across participating classes and reduce any stigma attached to desk cycle use), but only participants with a score of four or more were included in the analysis. A total of 99 pupils in the 12

participating classes met these inclusion criteria. 65% of the study population were boys and 35% girls.

Assignment to condition

Whole classes were assigned to the intervention or control group. The number of participating classes at each school and the method for assigning classes to be in the intervention or control group can be seen in Table 2.

TABLE 2

School	School size	Intervention group classes	Control group classes	Assignment to condition
STAR Academy	One form entry	1 x Year 6 class	1 x Year 5 class	Coin toss to determine which year group would be the intervention class.
Moorpark Junior School	Two form entry	1 x Year 6 class	1 x Year 6 class	Coin toss to determine which Year 6 class would be the intervention class.
Sandford Hill	Two form entry	1 x Year 5 class 1 x Year 6 class	1 x Year 5 class 1 x Year 6 class	Coin toss to determine which class in each year group would be the intervention class.
Crescent Academy	Three form entry	1 x Year 5 class 1 x Year 6 class	1 x Year 5 class 1 x Year 6 class	Class names drawn from a hat to determine which class in each year would not participate, which would be the intervention class and which would be the control class.

A spreadsheet was used to compare the mean and standard deviation of hyperactivity SDQ pre-test scores for the intervention and control groups to ensure the groups had similar levels of teacher-reported hyperactivity before the intervention began.

Innovation

The intervention took place over a 15-week period from the end of January 2018 until May half-term. During this time every pupil in the intervention group was given access to a desk cycle during maths lessons (typically every morning). Participating pupils did not have access to the desk cycles at any other time in the day. Pupils in the control group did not have access to a desk cycle at any time.

A desk cycle is a small, portable pedal unit which fits under a desk allowing a person to pedal whilst doing work. The desk cycles used are only 24cm high and can be used under a low desk. The units work on a magnetic resistance so are silent, ensuring that they didn't distract other children or the staff involved in the study. Each cycle has a display which was covered up so that the children didn't become competitive or fixated on the cycle. Teachers or teaching assistants were asked to record the distance each child pedalled at the end of every maths lesson. The children were able to decide for themselves how they used the cycles. Some children pedalled continuously, some children had a stop–start approach and some pedalled forwards and backwards. Other children in the class were permitted to use the desk cycles in other subjects; this was to avoid any jealousy or related class-management issues.

One child in one of the Year 6 intervention groups was diagnosed with an Autistic Spectrum Condition in November 2017. He struggled with the idea that he could only use the desk cycle in maths and it was agreed that he would be allowed to use the desk cycle throughout the day.

It was explained in detail to each member of staff how to select the children for each group and feedback was given on the group selection. Instruction was also provided on how to determine the waist-to-height ratio. All staff were given generic documentation to report back on pre- and post-study data as well as generic consent letters to parents. There were follow-up visits to schools throughout the course of the study (approximately every four weeks) to observe the study conditions and to ensure consistency of delivery, as well as to survey the children involved in the study.

Outcome measures

Hyperactivity

The Strengths and Difficulties Questionnaire (SDQ) is a brief behavioural screening questionnaire for use with 3–16 year olds. The SDQ includes five scales but only the hyperactivity scale was used in this study. When using only part of the SDQ it is recommended that two or more scales are completed: both the hyperactivity scale and the emotional scale questions were completed by the teachers but only the scores for the hyperactivity scale were relevant to this study. A maximum score of 10 can be scored on the hyperactivity scale. Class teachers completed the hyperactivity scale of the SDQ for all pupils in their class in early January 2018. The hyperactivity scale of the SDQ was completed again for all participating pupils by class teachers in late May 2018.

Maths attainment

Participating Year 6 pupils completed the 2017 SATs arithmetic paper in mid-January 2018. The 2017 SATs arithmetic paper was taken again by participating pupils in late May as a post-test. In both cases the maths papers were marked by class teachers out of a maximum possible score of 40.

Participating Year 5 pupils completed the Year 5 Maths Hub arithmetic paper as a pre-test in mid-January 2018. The Year 5 Maths Hub arithmetic paper was repeated as a post-test in late May 2018. The maths papers were marked by the class teacher.

Fitness outcomes

Daily mile: All pupils in all participating schools complete the daily mile, where pupils run, jog or walk for one mile each day. It should be noted that not all courses were exactly one mile (eg, the course was often a set number of laps of the playing field, which may have been slightly

more or slightly less than a mile) and not all schools required pupils to run the mile every day. The time taken for participating pupils to complete the daily mile was recorded on one occasion in mid-January 2018 and one occasion in late May 2018.

Waist-to-height ratio: The waist-to-height ratio (waist circumference divided by height) of all participating pupils was calculated in mid-January 2018 and late May 2018.

Process evaluation

Observations

Observations were carried out by the pilot study lead teacher approximately every four weeks in each of the four schools. Observations focused on the use of the cycles to ensure that the children involved in the study only used the cycles in maths. It was also noted whether the distance that the children had cycled was being accurately recorded at the end of each session. The children's differing methods of using the cycles were also noted.

Interviews

109 out of the 120 children involved in the study, including the children with a score of three or below on the SDQ, were interviewed by the lead teacher; 11 children in total from the four schools were absent when the survey was conducted. The surveys were conducted midway through the study to ensure that the novelty of using the desk cycles had worn off. The children were interviewed on their own outside of the classroom so that their views were not influenced by other children.

Children in the intervention groups were asked questions 1 to 16, and the children in the control groups were asked questions 7 to 16, from the questions below.

The questions were phrased specifically to try and determine the children's attitudes towards the following:

- using the desk cycles
- maths, as well as their focus and concentration in maths
- exercise.

The children gave open responses to the questions asked.

1. Do you like using the desk cycle?
2. When and how do you use the desk cycle?
3. Are you always aware of when you use the desk cycle?
4. Does using the desk cycle help you in any way?
5. Are you able to use the desk cycle and focus on maths at the same time?
6. Is there any time in the lesson when you don't use the desk cycle?
7. Do you like doing maths?
8. Do you find maths easy or difficult?
9. Do you ever do maths at home?
10. Do you think it is important for you to do well in maths?
11. Do you find it easy to concentrate when you do maths?
12. Do you get easily distracted in maths?
13. Do you find maths interesting?
14. Do you like doing exercise?

15. Do you think doing exercise is good for you?
16. Do you do a lot of exercise at school and/or at home?

In addition to the survey, schools were invited to take part in a film which gave both staff and children an opportunity to voice their opinion on the impact, if any, of using the desk cycles in a classroom setting. Filming took place in the schools during the second half of the summer term. Not all children were available because of trips and other activities and some children preferred not to be filmed, so there wasn't a specific selection process in terms of who took part.

A case study of a pupil in one of the Year 6 intervention groups was carried out. This pupil was diagnosed with an Autistic Spectrum Condition in November 2017 and was allowed to use the desk cycle throughout the day. Comments were recorded by the child and the member of staff pre and post-study with the parents asked for comment at the end of the study.

Analyses

Outcome measures

The pre- and post-test data were compared. Mean changes in pre- and post-test data were calculated for waist-to-height ratio, time taken to complete the daily mile and scores achieved by each child on the maths tests. As the SDQ is a scale measurement, changes in median ratings were calculated. Effect sizes were then calculated for each of the measures to see if greater progress was made by the intervention group or the control group.

Process analyses

There was a marked contrast between the responses given by the children involved in the intervention and the children participating in the control for questions 7–16. The children in the intervention were very keen to offer their opinions and talked at length, whereas the children in the control were quite uninterested and monosyllabic in terms of their answer, often responding that they didn't know. Therefore an analysis of these questions wasn't considered viable due to insufficient comparable data. The data that was processed was intervention group pupils' answers to questions 1 to 6. This included quantitative analysis of some of the questions e.g. "Are you always aware of when you use the desk cycle?" when a yes or no answer was given and the number of responses was calculated. Whereas a more thematic analysis was used for questions where a range of responses were provided by the children.

Cost

TABLE 3: INTERVENTION AND EVALUATION

Budget item	Amount
50 desk cycles @£149.00.	£7450
Seven days supply cover to four schools to deliver the study @£150 per day. Breakdown:	£4200

• half-day assembly of desk cycles • half-day meeting to go through protocol and data collection process • half-day to complete SDQ pre-tests, determine intervention and control groups and send out consent letters • half-day x 2 to support data collection for daily mile, waist-to-height ratio and maths, and calculate averages for intervention and control groups • half-day for SDQ post-tests and film focus group • four days in total for ongoing data collection and recording of use of desk cycles (15 minutes per day for 15 weeks).	
13 days payment to study lead to deliver the study @£250 per day. Breakdown: • 4 x half-day meetings to set up study in each school • 4 x half-days to assist SDQ completion and determine intervention and control groups in each school • 4 x half-day observations and questioning, writing up of transcripts, carrying out thematic analysis of qualitative data • one day filming of focus groups.	£3250
Six days to complete the evaluation and report by the study lead @£250 per day. One day per school to compare data and 2 days to complete the report.	£1500
Filming and editing of footage to produce short film of children's responses.	£500
Total expenditure	£16,900

TABLE 4: INTERVENTION ONLY

Budget item	Amount
50 desk cycles @£149.00.	£7450
Half-day assembly of desk cycles @ £75 per school.	£300
Total expenditure	£7750

The cost of the intervention per pupil was £155, which covers the purchase and assembly of desk cycles. There are no on-going costs, so costs per pupil would reduce over time.

Results

Outcome findings

There are differences in the sample sizes for the different measures. Other than child absence there are two reasons for this. Firstly, there were seven Year 6 intervention and control classes and only five Year 5 intervention and control classes. Secondly, pupils were only included in the sample if they scored four or more on the hyperactivity scale of the SDQ. These pupils were not distributed evenly across classes and year groups.

SDQ hyperactivity scale

Sample size = 99; 50 in the intervention group and 49 in the control group.

The table below shows the mean and median change in the hyperactivity scale scores for intervention and control group pupils over the 15 week period.

TABLE 5

	Intervention group (N=50)	Control group (N=49)
Mean pre-test SDQ score	5.94	6.06
Mean post-test SDQ score	4.06	5.98
Mean change	-1.88	-0.08
Median change	-2	0
Effect size	+0.93	

Further analysis shows that, out of an intervention group of 50 children, 2 children's scores increased, 8 children's scores stayed the same and 40 children's scores decreased. In the control group of 49 children, 11 children's scores increased, 22 remained the same and 16 children's scores decreased.

TABLE 6: SDQ HYPERACTIVITY SCALE CHANGE IN RAW SCORES FOR THE INTERVENTION GROUP.

Hyperactivity scale	-5	-4	-3	-2	-1	0	+1	+2	+3	+4
Number of children	1	10	6	14	9	8	0	0	2	0

TABLE 7: SDQ HYPERACTIVITY SCALE CHANGE IN RAW SCORES FOR THE CONTROL GROUP

Hyperactivity scale	-5	-4	-3	-2	-1	0	+1	+2	+3	+4
Number of children	0	0	4	5	7	22	4	3	1	3

Year 5 maths test (Year 5 Maths Hub arithmetic paper)

Sample size = 38 in total; 15 in the intervention group and 23 in the control group.

Table 8 shows mean maths test scores for each Year 5 group over the 15-week period.

TABLE 8

	Intervention group (N=15)	Control group (N=23)
Mean pre-test score	14.07	9.96
Mean post-test score	18.80	15.26
Mean progress	4.73	5.30
Effect size	-0.16	

Year 6 maths test (2017 Year 6 SATs arithmetic paper)

Sample size = 58 in total; 35 in the intervention group and 23 in the control group.

Table 9 shows the mean in maths test scores for each Year 6 group over the 15-week period.

TABLE 9

	Intervention group (N=35)	Control group (N=23)
Mean pre-test score	20.89	14.87
Mean post-test score	30.03	28.26
Mean progress	9.14	13.39
Effect size	-0.52	

The negative effect sizes in maths were unexpected, especially the large negative effect size in Year 6. While an analysis of maths progress by pre-test SDQ score had not been planned, it was felt that looking at this may help in understanding these results. Effect sizes for maths progress were calculated in the following groupings in each year group:

- Pupils with pre-test SDQ scores of 4–5, as this is categorised as ‘close to average’ in the SDQ.
- Pupils with pre-test SDQ scores of 6–7, as this is categorised as ‘slightly raised’ in the SDQ.
- Pupils with pre-test SDQ scores above 8, as these scores are categorised as ‘high’ or ‘very high’ in the SDQ.

TABLE 9: EFFECT SIZES FOR MATHS PROGRESS

	Year 5	Year 6
Pre-test SDQ score 4-5	-0.39598 (n=20)	-0.80093 (n=25)
Pre-test SDQ score 6-7	0.095117 (n=13)	-0.70941 (n=17)
Pre-test SDQ score 8+	N/A* (n=5)	0.098148 (n=16)
Overall	**-0.15615 (n=38)**	**-0.52418 (n=58)**

No Year 5 intervention group pupils scored 8 or above so an effect size could not be calculated.

Please note, the small numbers of pupils in each group and the unplanned nature of this analysis limit the conclusions which can be drawn. However, the analysis could be used to consider areas for future research.

Daily mile

Sample size = 80 in total; 40 in the intervention group and 40 in the control group.

Table 10 shows the mean change in time (in seconds) taken by pupils in the intervention and control groups to complete the daily mile over the 15-week period.

TABLE 10

	Intervention group (N=40)	Control group (N=40)
Mean pre-test time	11 minutes 19.7 seconds	10 minutes 58.5 seconds
Mean post-test time	10 minutes 53.8 seconds	10 minutes 41.9 seconds
Mean progress	-25.9 seconds	-16.65 seconds
Effect size	+0.11	

Waist-to-height ratio

Sample size = 86 in total; 50 in the intervention group and 36 in the control group.

Table 11 shows the mean change in waist-to-height ratio over the 15-week period.

TABLE 11

	Intervention group (N=50)	Control group (N=36)
Mean ratio pre-test	0.4664	0.4683
Mean ratio post-test	0.4566	0.4633
Mean change	-0.0098	-0.005
Effect size	+0.15	

Process evaluation findings

Pupil views

56 children who had access to a desk cycle were interviewed by the pilot lead teacher. This number includes all children who had access to a desk cycle who were present when the interviews took place.

Questions 1–6 from the survey were analysed:

1. Do you like using the desk cycle?
2. When and how do you use the desk cycle?
3. Are you always aware of when you use the desk cycle?
4. Does using the desk cycle help you in any way?
5. Are you able to use the desk cycle and focus on maths at the same time?
6. Is there any time in the lesson when you don't use the desk cycle?

Question 1 Do you like using the desk cycle?

Out of the 56 children in the intervention groups who were surveyed:

- 51 said that they liked using the cycles
- three children didn't like using the cycles
- two children said they didn't use the cycles.

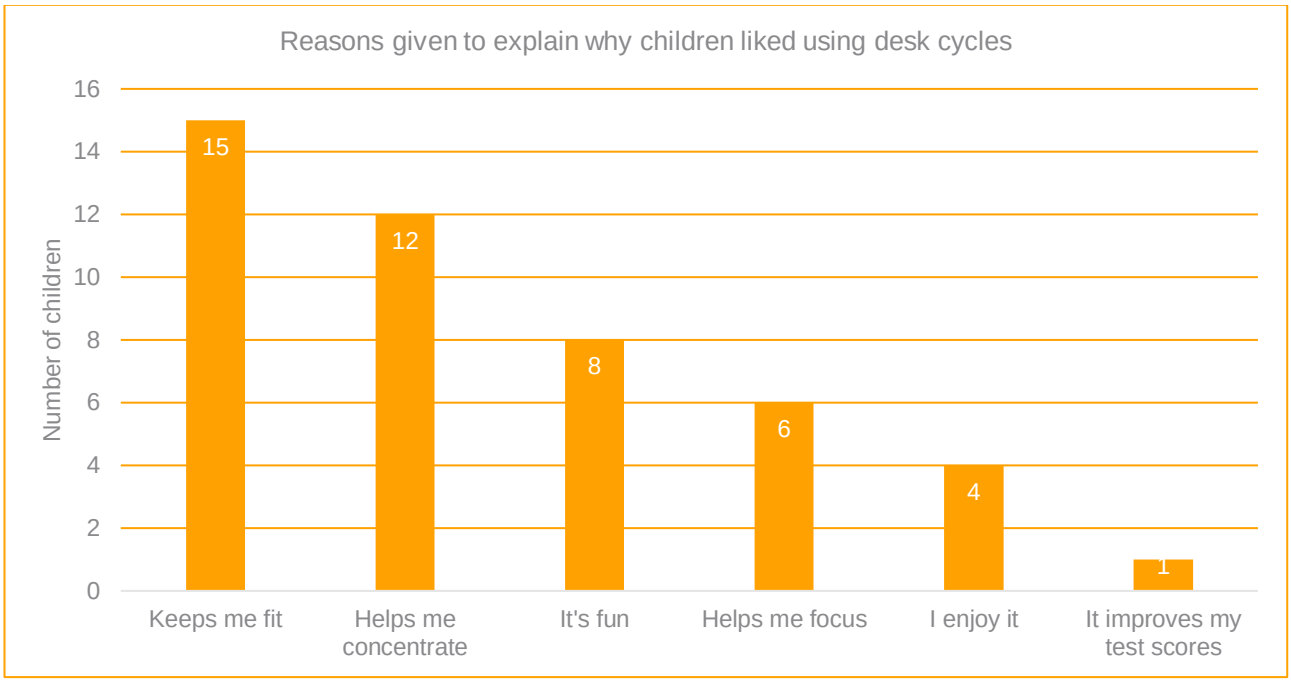
Out of the three children who said that they didn't like using the desk cycles, one said that they found it difficult to draw shapes when cycling, one said that their feet came out of the pedals and one said that they hit their knees on the desk.

One of the two children who said they didn't use the desk cycle said that they couldn't focus on their maths when they used the cycle. The other child who said they didn't use the cycle was observed using the desk cycle during classroom observations (their use of the desk cycle was confirmed by teacher feedback).

However, 46 of the children gave reasons to explain why they liked using the desk cycles (Figure 1). Of these, 19 children gave reasons that can be linked to their approach to learning (eg, that it improved their concentration, focus and test scores). Additionally, 15 children

attributed using the desk cycles to improvements in their fitness and 12 gave a positive emotional response.

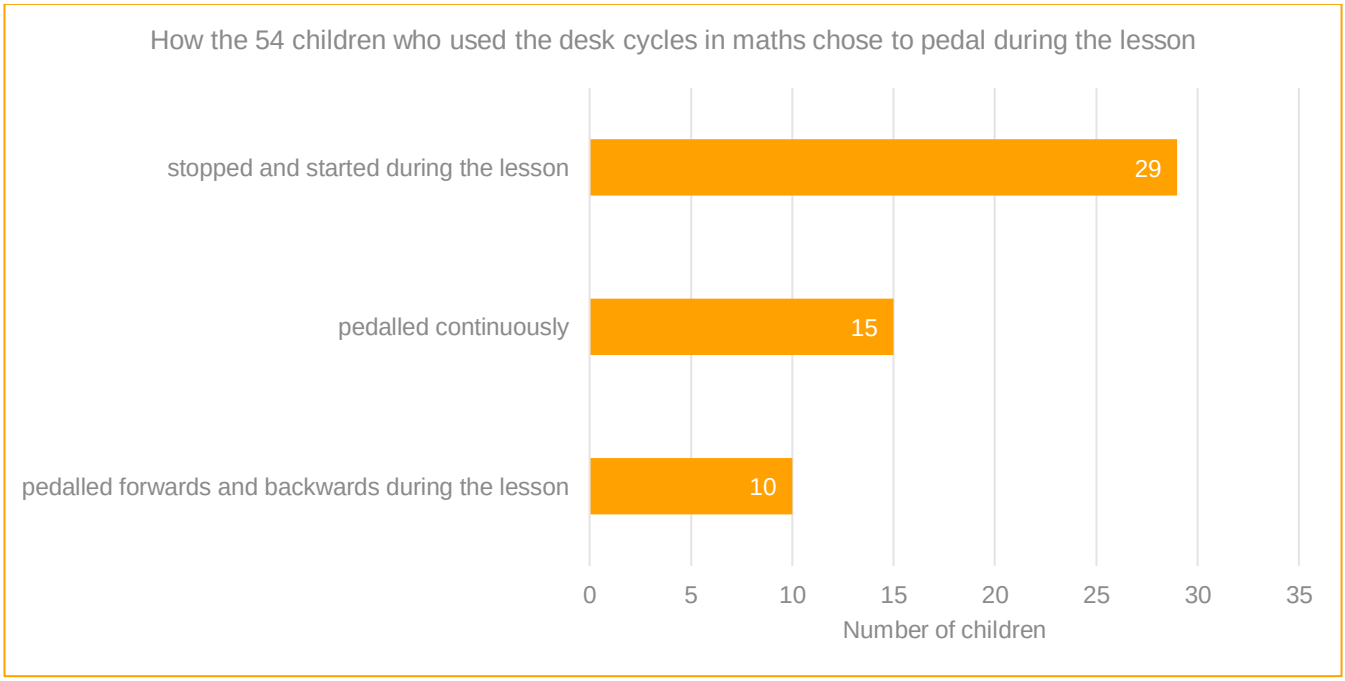
FIGURE 1



Question 2: When and how do you use the desk cycle?

Out of the 56 children who were surveyed, 54 children used the desk cycles and two said that they didn't use the cycles. Children had access to the desk cycles but they could decide how they wanted to use them.

FIGURE 2



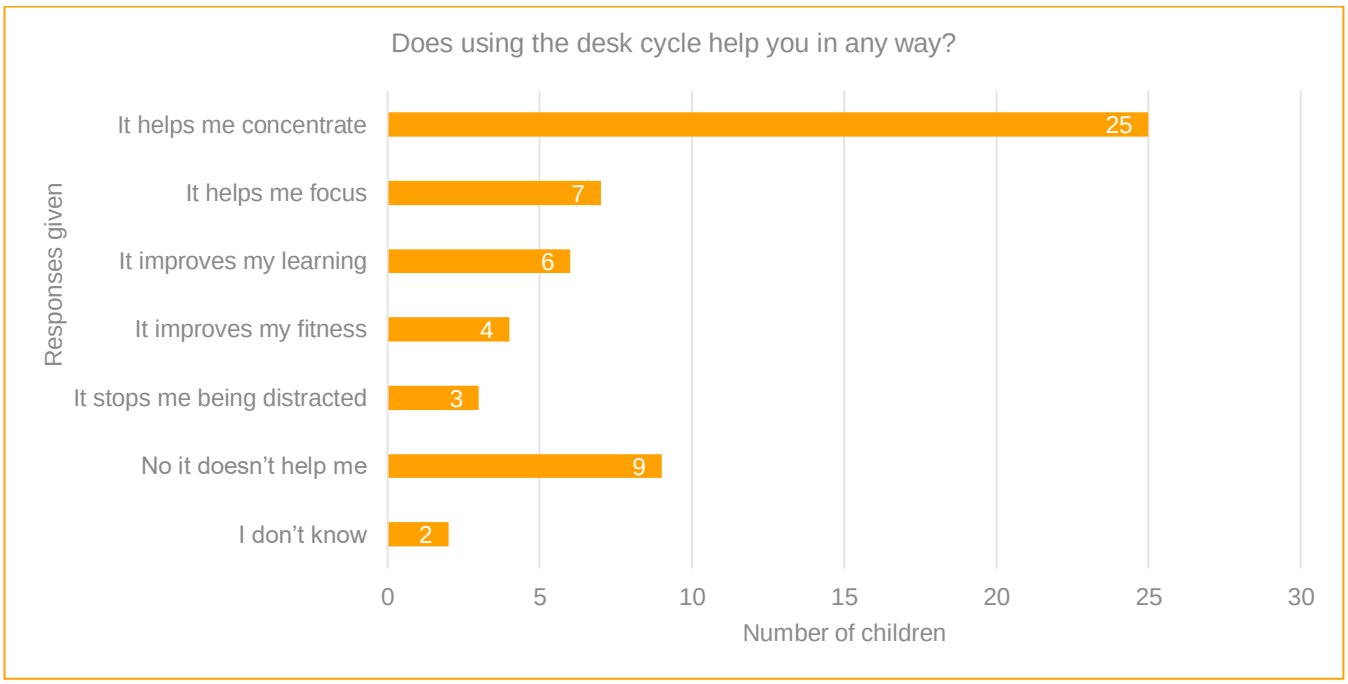
Question 3: Are you always aware of when you use the desk cycle?

Out of the 54 children who were using the desk cycles, 23 said that they were aware of when they used the desk cycle and 31 said they were not aware of when they were using the desk cycle.

Question 4: Does using the desk cycle help you in any way?

Figure 3 shows the range of responses given to Question 4.

FIGURE 3



Forty-one of the responses given gave reasons that can be linked to their approach to learning, in that they said it helped concentration and focus, it stopped them being distracted and it improved their learning.

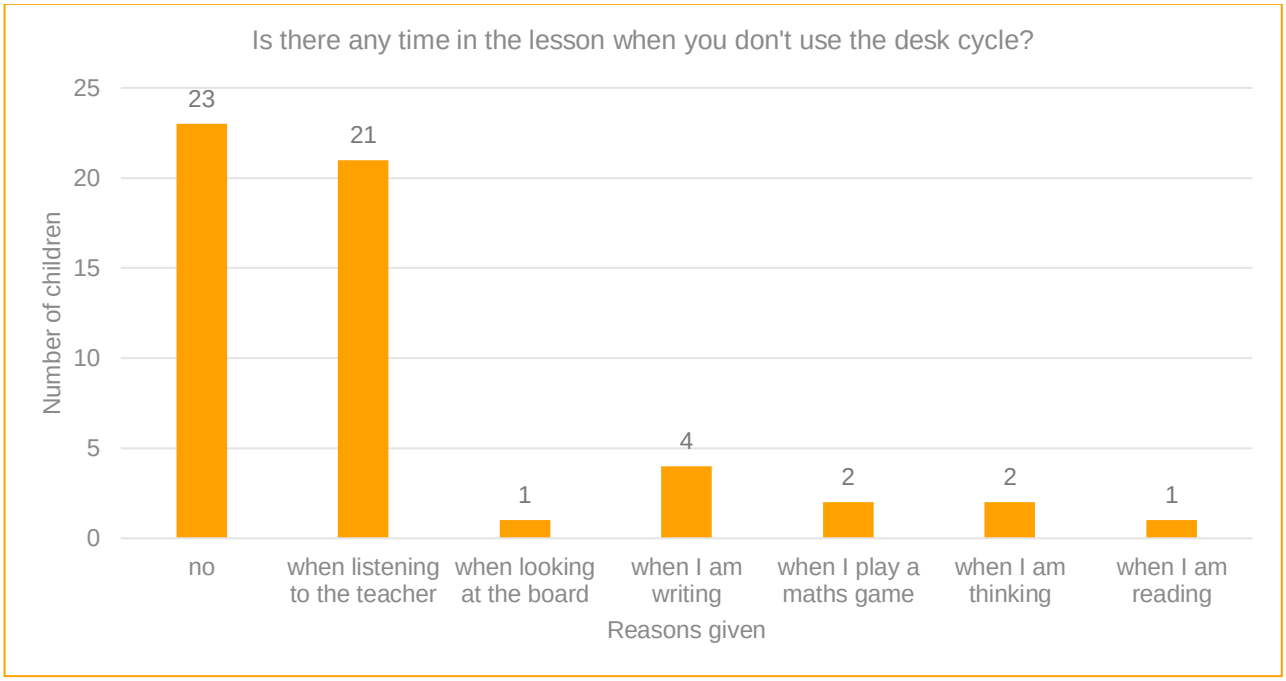
Question 5: Are you able to use the desk cycle and focus on maths at the same time?

Out of the 56 children who were using the desk cycles, 52 said that they were able to focus on maths and pedal, and four said they were not able to focus on maths and pedal. The two children who rarely used a desk cycle gave this as the reason for not liking the cycles.

Question 6: Is there any time in the lesson when you don't use the desk cycle?

A wide range of reasons were given by the 54 children who said that they used the desk cycle. However 42% responded that they could use the desk cycle at any point in the lesson. Figure 4 shows the range of reasons given.

FIGURE 4



Case study

Child A is a Year 6 pupil with a diagnosis of an Autistic Spectrum Condition. As he struggled with the concept of only using the desk cycle in maths lessons it was agreed that he would have access to the desk cycle all day. Both child A and their class teacher reported that his level of concentration improved following access to the desk cycle and that he was less inclined to fidget or rock back on his chair. His teacher felt that he was able to focus on his work over longer periods of time. A major change in his behaviour was that he stopped wearing his soundproof headphones, which he had worn to reduce the sensory factors in the classroom (see appendix for transcript).

Film

In addition to the survey, a film was produced which gave staff and children the opportunity to respond verbally to a range of questions. The questions posed to the children were similar to those in the survey. The filming took place 10 weeks after the survey was completed, but the comments made on the film were consistent with the responses made during the survey.

Google link to view the Desk Cycle Pilot Film:
https://drive.google.com/open?id=1_l4LEA9sy1_qIoJSwf9FChm0hV30CBHK

Classroom observations

During the classroom observations it was interesting to see the range of different ways of cycling that the children used. Some children pedalled almost continuously throughout the lesson, whereas some children would stop for several minutes and then start again. The pace that the children cycled was also very varied. The lead teacher expected to see a decline in use once the novelty of using the desk cycles had worn off, but that wasn't apparent with children

seemingly adopting a habitual approach to the cycles. The lead teacher noticed that one child pedalled extremely quickly when they held their hand up to answer a question. The use of the desk cycles didn't appear to distract other children or the classroom teacher. The class teachers didn't ask the children to stop using the cycles when they were talking or using the board, however some children had to stop using the cycles to enable them to turn round on their chairs to see the front of the classroom and some chose to stop. On occasions the lead teacher was carrying out classroom observations when the maths lessons ended and children had to swap over. This was a little disruptive as either the desk cycles were moved or the children had to move. At the start of the pilot it was made clear to children that they could choose if and when they wanted to use the desk cycles and it was evident that they all adopted a very individual approach.

Discussion/Conclusion

Interpretation of findings

In this evaluation, having access to a desk cycle in a classroom setting reduced teacher reported hyperactivity levels for children with existing raised levels of hyperactivity. 80% of the children in the intervention group saw a drop from between 1 and 5 points on the 10-point SDQ hyperactivity scale in contrast with 32% in the control group. These results are very similar to the experience of Paramus Elementary School in New Jersey and other schools in the US, which found that children with access to desk cycles were less inclined to fidget and move around and appeared to be more focused on their work.

However unlike the American experience, there did not appear to be a positive impact on academic outcomes. In this evaluation, negative effect sizes were found for maths progress in both Year 5 and 6 showing that, on average, pupils in the control group made more progress than pupils in the intervention group. Two possible reasons for these results are hypothesised:

- In both year groups the control group average was quite a bit lower than the intervention group average at the pre-test. This could have influenced the progress they made: for example, it is possible the control group's lower average prior attainment meant that more pupils in the control group received additional maths support during the 15 weeks of the evaluation.
- There is also the possibility that desk cycles facilitate learning for pupils with high levels of hyperactivity (by keeping them focused and on task), but may have a negative impact on learning for pupils who have average or slightly raised levels of reported hyperactivity (perhaps, ironically, by distracting them from their on-task behaviour). However the very small numbers of pupils included in each analysis and the fact that the analysis of maths progress for pupils with different pre-test SDQ scores was not planned in advance means that it is difficult to draw any conclusion without further research.

Nevertheless it would be extremely difficult to attribute any improvements in maths to any one intervention, as during this period other interventions such as booster classes' and one-to-one support were taking place. It is also worth noting that one of the schools sets classes by prior attainment in maths, which might have affected the results.

There was a very small positive effect of desk cycles on waist-to-height ratio and on the time taken to complete the daily mile. In terms of the daily mile, the data collected was imperfect as the length of the course differed between schools and children did not run the same number of times per week. In one school children rarely ran during the spring term as the course was on grass. A number of children did comment that they felt fitter and that their legs felt stronger. One girl attributed the improvements in her swim times to using the desk cycle, but this is completely unsubstantiated. Changes to waist-to-height ratio are equally difficult to attribute solely to the use of the desk cycle. That said, it would be interesting to do a larger and longer study to see if the results were replicated or became more pronounced.

Limitations

A number of limitations of the study have been identified:

1. The sample size of this study is quite small so therefore the same results might not be achieved in a larger study.
2. The length of the study was relatively short so it is not known whether the novelty of using the desk cycles might have worn off over a longer period of time.
3. Equally, on reflection 15 weeks isn't really long enough to see a measurable impact on maths scores and levels of fitness.
4. Initially staff were asked to record the distance cycled by each child in a maths lesson. Due to time constraints on the teacher or the teaching assistant responsible this data was not always captured. In classes where other children used the cycles the display unit was not always reset so incorrect data was logged. This did not prevent the research questions from being answered as they all looked at access to a desk cycle, not usage. However, it would have been interesting to see if the distance pedalled had any relationship to changes in hyperactivity score.
5. The lack of prior research in this area has also had a negative impact on the design of the study. The tool used to measure the impact of the use of desk cycles on maths attainment may not have been the most appropriate. The study by Scudder et.al, 2013 showed that people, after freshly completing a session of exercise, are better able to concentrate and ignore distractions. A research tool that measures maths fluency pre- and post-lesson rather than a longitudinal measure may have been more relevant to this pilot.
6. Year 6 participants carried out the post-test after they had completed their actual SATs, so motivation levels were probably not at their highest, although this would apply equally to the intervention and control group.
7. The SDQ was completed by the class teacher. This is in line with recommendations on how to use the behavioural screening tool, in that ratings should be completed by someone who has observed the child's behaviour over a period of time. This does mean that the assessor knew whether participants were in the intervention or control group meaning their scoring may be open to unconscious bias. The assessment might have benefitted from both the class teacher and another member of staff not associated with the evaluation completing the SDQ together, as the second reviewer may have been better able to identify if there was a clear change post-intervention.
8. When questioning children there are always issues with the use of language and the interpretation of the questions by the child. There is also a tendency for children to give the perceived 'correct' answer, despite being told that there is no right or wrong answer and that it is only their opinion that counts. In this evaluation there were some inconsistencies in the responses given by the children, in particular in relation to questions 7–16.
9. Another consideration to take in to account is that the control and intervention groups were checked for equivalence of pre-test SDQ score but the two groups' pre-test scores for maths and fitness measures were quite different. It wasn't feasible to ensure similarity of the groups across all three areas.

Implications for practice

This evaluation does not provide definitive advice for practitioners on the use of desk cycles. The research in to their use is novel therefore there is a lack of previous research with which to compare results. Some American studies purport a positive impact but specific data is not publically available. However this evaluation does provide some initial suggestions as well as advocating a degree of care on their use until further research has been undertaken. It also provides some reflections on the introduction of novel, un-researched approaches into classroom practice.

In relation to the first research question, there is evidence that the use of desk cycles for 15 weeks reduced hyperactivity levels of Year 5 and 6 pupils with high levels of hyperactivity. With regard to the second research question, access to desk cycles does not appear to improve the attainment in maths of Year 5 and 6 pupils with high levels of hyperactivity and may have a small negative impact. Concerning the third research question, access to desk cycles may have a small positive impact on the fitness levels of Year 5 and 6 pupils with high levels of hyperactivity.

Schools considering introducing desk cycles should monitor the impact of the cycles in their own settings. In particular, making the desk cycles available to pupils who are not showing high levels of hyperactivity should be done with a level of caution, as there were indications that this might have a negative impact on outcomes in maths.

This study also illustrates the challenges of introducing new, un-researched approaches into the classroom. There is very little existing research suggesting how, when, where, and for whom these desk cycles might be a useful intervention. This study presents intriguing potential implications towards the effects of desk cycle use in the classroom, however further exploratory research is required to provide more definitive and reliable guidance.

Implications for further evaluation

As limitations of the study included both the sample size and length of the study it would be interesting to repeat the research on a larger scale. The benefits noted by the child with a diagnosed Autistic Spectrum Condition poses the question of whether using a desk cycle may help children with similar problems and suggests that future research in a special school might be worth exploring. It would be interesting to use a different method of assessing maths; for example, maths fluency during the lesson might be a better measure of the impact, if any, of the desk cycles on maths learning. During interviews, some children felt that using the desk cycles helped to reduce their stress and anxiety levels; further research in this area may be beneficial in the context of increasing concerns about children's mental health.

Conclusions

This study supports the view that access to desk cycles in a primary school classroom setting for 15 weeks reduces the teacher-reported hyperactivity levels of Year 5 and 6 pupils with high initial levels of hyperactivity. The effect size of 0.93 shows that there was a large reduction in the teacher reported hyperactivity levels of the intervention group in comparison to the control group. In addition, the comments made by both staff and children reinforce the impact that use of the cycles had on children's behaviour in the classroom; it was reported that children were less likely to fidget or rock on the chairs and appeared more focused on their work.

In contrast there was some evidence that the use of desk cycles had a negative impact on attainment in maths, in particular on children with lower levels of hyperactivity; children with higher levels of hyperactivity appeared to experience less of a negative impact. There was a small positive effect size on the fitness levels of the children and the waist-to-height ratio in the intervention group, but this is very difficult to attribute to the use of the desk cycles. It would be interesting to see if a longer study leads to a sustained change in fitness levels.

The impact that using a desk cycle had on the child with ASC was very marked, resulting in the child no longer feeling the need to wear headphones during class. The child commented that they felt able to concentrate better and saw an improvement in test scores. This is a very individual response that may or may not be replicated in further research.

It is clear from the process evaluation that the children responded very positively towards using the desk cycles, with 91% of the children in the intervention group stating that they liked using the cycles. When asked if they thought that using the cycles helped them in any way, 73% gave a response linked to their approach to learning such as reporting an increase in focus and concentration. 93% of the children using the desk cycles said that they could use the desk cycle and focus on maths at the same time and only one intervention group participant opted not to use a desk cycle.

Due to the design, size and duration of this pilot study further research is needed to see if desk cycles have any impact on maths fluency during the lesson or whether or not they do detract in any way on maths attainment. Research in to a physically active learning environment for children with autism or children with other learning difficulties would also be of interest.

Further reading

Research that highlights the problems of being sedentary

Department of Health, Physical Activity, Health Improvement and Protection (2011). Start Active Stay Active; A report on physical activity for health from the four home countries' Chief Medical Officers. London: Department of Health.

Hegarty L, Mair J.L, Kirby K., Murtagh E.M, and Murphy, M.H. (2016). School-based interventions to reduce sedentary behaviour in children: A systematic review. *AIMS Public Health*, 3, 520–541.

Hinckson E, Salmon J, Benden M, Clemes SA, Sudholz B2, Barber SE, Aminian S, Ridgers ND (2016). Standing classrooms: Research and lessons learned from around the world. *Sports Medicine*, 46, 7, 977–987.

Nader, Bradley, Houts, McRitchie and O'Brien (2008). Moderate-to-vigorous physical activity from ages 9 to 15 years. *The Journal of the American Medical Association*, 300, 3, 295–305.

Nike, Inc. (2012). Designed to Move – A physical activity action agenda.

Public Health Profiles for Stoke-on-Trent. Retrieved from https://fingertips.phe.org.uk/profile/health-profiles

Riddoch CJ, Andersen LB, Wedderkopp N, Harro M,Klassonheggebø L, Sardinha LB, Cooper AR, and Ekelund U, (2004). Physical activity levels and patterns of 9- and 15-yr-old European children. *Medicine and Science in Sports and Exercise*, Vol. 36, No. 1, pp. 86–92.

Sedentary Behaviour and Obesity Expert Working Group (2010). Sedentary behaviour and obesity: Review of the current scientific evidence. London: Department of Health.

Research that highlights the link between exercise and cognitive performance

Booth J, Leary S, Joinson C, Ness A, Tomporowski P, Boyle J & Reilly J (2014). Associations between objectively measured physical activity and academic attainment in adolescents from a UK cohort. *British Journal of Sports Medicine*, 48, 265–270.

de Greeff JW, Bosker RJ, Oosterlaan J, Visscher C, and Hartman E (2017). Effects of physical activity on executive functions, attention and academic performance in preadolescent children: a meta-analysis. *Journal of Science and Medicine in Sport*, 5, 501–507.

Drollette, ES, Komisarz, CE, Scudder, MR, Raine, LB, and Hillman, CH (2013). Modulation of brain function in children during and after exercise. *Medicine and Science in Sports and Exercise*, 45, 365–365.

Etnier, Labban, Piepmeier, Davis and Henning (2014). Effects of an acute bout of exercise on memory in 6th Grade children. *Pediatric Exercise Science*, 26, 3, 250–258.
Eyewitness News (2016, 15th January). First graders in Paramus are fidgeting less thanks to pedaling desk cycles. Retrieved from https://abc7ny.com/education/first-graders-in-paramus-are-fidgeting-less-thanks-to-pedaling-desk-cycles/1160727/

Ogoe, R. (2015, 28th June). The kinetic classroom, Retrieved from http://www.edimprovement.org/2015/06/kinetic-classroom-pedal-desk-adhd-mind-bodyconnection/

Public Health England (2014). The link between Pupil Health and Wellbeing and Attainment: A briefing for head teachers, governors and staff in education settings. London: Public Health England.

Ratey JJ and Hagerman E, (2010). Spark: The revolutionary new science of exercise and the brain. London: Quercus.

Ratey JJ, (2012, 18th November. Run, jump, learn! How exercise can transform our schools. Retrieved from https://www.youtube.com/watch?v=hBSVZdTQmDs

Read and Ride Program (2010, 2011). Read and Ride Program Data. Retrieved from http://www.readandride.org/Read-And-Ride-Data.html

Research to support use of waist measurement to height ratio rather than BMI

Leeds Beckett University (2017, 6th June). Waist-to-height ratio more accurate than BMI in identifying obesity, new study shows. Retrieved from www.sciencedaily.com/releases/2017/06/170606090942.htm

Swainson MG, Batterham AM, Tsakirides C, Rutherford ZH, and Hind, K, (2017). Prediction of whole-body fat percentage and visceral adipose tissue mass from five anthropometric variables. *PLOS ONE*, 12 (5): e0177175 DOI: 10.1371/journal.pone.0177175

Appendix: Case study of child A

Child A uses his desk cycle all day, every day.

Background:
Diagnosed November 2017 with ASC.

Child A's comments pre desk cycle:
I struggle to focus and I always tilt back/ rock back on my chair.
I just keep on talking to children sometimes instead of focusing 100% on my work.

Parent comments pre desk cycle:
All he wants to do is play on the computer.

Teacher comments pre desk cycle:
In maths sessions (which last the whole of the morning), Child A's attention may not be sustained on longer investigations. He becomes distracted by sensory factors, particularly noise and frequently rocks in his chair.

Child A's comments during/post the use of the desk cycle:
I focus more now because pedalling stops me from fidgeting
I like it because it keeps me fit.
I don't need to wear my head phones anymore because I can concentrate on my work better. That means I get better scores on my tests.
It improves my muscles in my legs, I need that, do you know why? Because I am going to go to an Outdoor Centre (PGL) where it's all hilly and you need to travel far to get to each activity.
I don't pedal when I am writing in English because the motion makes my hand shake and sometimes my handwriting doesn't look as neat.

Teacher comments:
Having the desk cycle has led to child A focusing on his learning for more extended periods, particularly as he no longer rocks or swivels round on his chair.
It seems to have enabled him to become more focused on his learning rather than sensory factors such as rocking, tapping, or turning on his chair.

Parent comments:
I haven't noticed much difference at home. It seems he's doing well at school, especially now he doesn't have to wear his sound proof headphones.

Contact us

+44 (0)1904 328166 info@the-iee.org.uk
Berrick Saul Building, University of York, York YO10 5DD
Twitter: @IEE_York the-iee.org.uk/

The Institute for Effective Education (IEE) is an independent charity working to improve education for all children by promoting the use of evidence in education policy and practice.

In collaboration with the Education Endowment Foundation (EEF) we support a national Research Schools Network and have developed resources aimed at people on the front line of education.

The Institute for Effective Education is a charity registered in England, charity number 1168744

Institute for
Effective Education
Empowering educators with evidence

Research
Schools Network