

Small-scale research study into the impact on the quality of teaching and learning where classroom infrared soundfield systems have been placed in secondary and primary schools in west London and Devon in the Academic Year 2008-09

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Executive Summary

Over the course of the Academic Year 2008-09, 62 classrooms in 7 primary and 7 secondary schools were provided with a portable infrared Soundfield Classroom Audio Technology (CAT) System.

The equipment comprised a small microphone worn round the teacher's neck, a handheld microphone for learners and a REDCAT all-in-one infrared flat panel CAT speaker placed at the back or side of the classroom.

The equipment works by evenly distributing the teacher's voice round the classroom, so that all learners can hear at the same level, no matter where they are sitting.

The research study aimed to find out what, if any, impact this would have on learner achievement, teacher well-being and the efficient use of lesson time.

Teachers and pupils were asked to complete a questionnaire at the end of the research period, focusing on their assessment of pupil behaviours, perceptions of using the system and the impact it had on them.

The results provided some very clear messages. Regardless of whether a teacher is working with students in a primary or secondary school, teaching a range of subjects or a specialist curriculum area, approximately 90 percent of them agreed that their students were able to hear and understand them better when using the CAT system.

Even teachers in newly built schools where strict design specifications are in force in relation to acoustical qualities required for effective teaching were just as much in need of the system as their colleagues teaching in older schools.

The following report contains all of the raw data gathered, along with analysis and other supporting information. The study found very clearly that the Soundfield system brought considerable benefits to students including:

- improved hearing and understanding of teacher instructions;
- improved on-task behaviour;
- improved self-confidence when speaking to the whole class.

For teachers, the key benefits of the system were judged to have been:

- less repetition of instructions;
- less vocal fatigue and tiredness;
- more time to support individual and small groups of learners.

From the evidence it would appear that serious consideration should be given to incorporating Classroom Soundfield Audio Systems into the design of any new school building or refurbishment in order to ensure the best possible teaching and learning environment.

Background

The research study involved placing four infrared portable soundfield audio systems in schools for a minimum of half a term (6-7 weeks) with several classrooms trialling the equipment for a full term (12-13 weeks). A total of 62 classrooms were installed with the system in 2008-09.

14 schools (7 primary and 7 secondary) in four London boroughs (Hillingdon, Ealing, Brent and Camden) and in Honiton, Devon volunteered to take part in the study on the understanding that the chosen teachers would use the system on a regular daily basis and complete a questionnaire at the end of the trial period. One of the primary schools failed to comply with this agreement with teachers neither consistently using the system nor completing and returning the questionnaire.

The equipment comprised a microphone worn around the teacher's neck, a handheld microphone for learners and a REDCAT all-in-one flat-panel speaker Classroom Audio System placed either at the back or side of the classroom depending on where it was most effective. Each teacher received a short (10-15 minute) placement and usage training session to ensure they made best use of the equipment in supporting effective teaching and learning, as well as a follow up visit to ensure they had no issues with the equipment.

The teacher questionnaires comprised eight statements focusing on the teachers' assessment of student behaviours and five statements focusing on teacher perceptions of the impact the infrared system had on them. Teachers were also invited to add any additional thoughts or comments about their experience, any evidence they drew on in grading three of the statements that focused on learner achievement, any recommended changes or improvements to the system, and any benefits they may have experienced.

Schools also agreed to ask a representative sample number of students to complete a short questionnaire comprising seven statements where they could register either their level of agreement or disagreement.

The age of the schools that took part in the study varied considerably, ranging from a Victorian primary school through to four secondary schools built, or with new classrooms added to the school, within the last six years of which two were brand new builds, i.e. became operational in the 2008-09 Academic Year. Other schools were housed in buildings constructed at different times throughout the last century.

I feel there has been a positive effect on the students' overall achievement as I have experienced fewer behavioural problems since using the CAT system. I believe this is due to the fact that I no longer have to raise my voice so often, which creates a calmer atmosphere in the class. My stress levels have also been greatly reduced as a result of the cat system. I love it.

Secondary School
English Teacher, L.B.
Ealing

Data collation

A total of 58 teacher questionnaires (28 primary and 30 secondary) and 554 student questionnaires (395 primary and 159 secondary) have been completed and returned to date. The following data tables set out the response totals with corresponding percentage figures:

Table 1a: Combined total of all teacher responses

Table 1b: Secondary teacher responses only

Table 1c: Primary teacher responses only

Table 2a: Combined total of all student responses

Table 2b: Secondary student responses only

Table 2c: Primary student responses only

I found that the CAT system was easy to use and a real benefit in PSHE and Food lessons. The students, especially younger students, liked to use the system generally and it was easier to hear their responses and contributions.

In Food lessons it meant that I was able to speak to the students across a large room and give general instructions relatively easily.

Secondary School
Life Skills / Food
Teacher, L.B.
Hillingdon

Data Analysis: Teacher Questionnaires

The data provides some clear and important messages. Whether a teacher is working with students in a primary or secondary school, teaching a range of subjects or a specialist curriculum area or teaching in an old or new school building, approximately 90 percent of them either somewhat agreed or strongly agreed that their students were able to hear and understand them better when using the CAT system and would like to keep the CAT system in their classrooms. In the first of these areas only one teacher (1.72%) of the 58 teachers that took part was somewhat in disagreement with the statement and in the second area only one teacher (1.72%) was strongly in disagreement with the statement, with one teacher (1.72%) somewhat in disagreement with the statement.

Even more striking is the judgement made by approximately 79 percent of the 58 teachers that their use of the CAT system helped improve the rate at which their students learned. The short research periods meant that it was not possible for teachers to produce significant quantitative data to support this judgement. However, in the UK there is a strong shift taking place where formal testing of Key Stage 1-3 students is being replaced by teacher assessment. It is increasingly recognised that teachers have the skills and intimate knowledge of their students to be able to make accurate and reliable assessments of their students' level of attainment and their rate of progress and the large majority of teachers judged that the soundfield system supported students in making greater progress than would otherwise have been the case.

Also noteworthy is that in only two areas – "Students in the back of the room participated in class discussions more often because they could hear and understand better." and "I felt more relaxed and less tired at the end of the teaching day when using the CAT system." - did the percentage of teachers either somewhat agreeing or strongly agreeing with the statements in the questionnaire fall below a two-thirds majority. Even then, the percentage of teachers in agreement with both statements remained above 60 percent.

Table 1a: Combined total of all teacher responses

SCHOOLS: ALL (13)

TEACHERS: 58

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
Student Behaviours						
1*My students were able to hear and understand me better when using the CAT system.	37 63.8%	16 27.6%	4 6.9%	1 1.7%	-	-
2*I feel that using the CAT system helped improve the rate at which my students learned because they were able to listen and understand better.	13 22.8%	32 56.1%	9 15.8%	3 5.2%	-	1
3 My students demonstrated an increased ability to follow directions when I used the CAT system.	20 34.4%	27 46.6%	8 13.8%	3 5.1%	-	-
4 I feel that the CAT system improved my students' attention skills and helped hold their attention.	23 40.3%	25 43.9%	7 12.2%	2 3.5%	-	1
5 I feel that the CAT system improved my ability to control and manage the classroom.	15 25.9%	26 44.8%	14 24.1%	3 5.1%	-	-
6 I experienced a decrease in the need to repeat directions and information (i.e. redirection and reinstruction).	19 32.8%	24 41.4%	12 20.7%	3 5.1%	-	-
7 My students benefited from using the microphone	26 50.0%	14 26.9%	11 21.1%	1 1.9%	-	6
8 Students in the back of the room participated in class discussions more often because they could hear and understand better.	14 25.0%	22 39.3%	18 32.1%	2 3.6%	-	2
Teacher Perceptions						
1 The system was comfortable and easy to use on a daily basis.	35 60.3%	19 32.8%	3 5.2%	1 1.7%	-	-
2 I felt more relaxed and less tired at the end of the teaching day when I used the CAT system.	15 25.9%	21 36.2%	13 22.4%	7 12.1%	2 3.4%	-
3 I experienced less voice/vocal strain when using the CAT system.	25 43.1%	19 32.8%	9 15.5%	3 5.2%	2 3.4%	-
4* I believe that using the CAT system had a positive effect on the students' overall achievement.	12 20.7%	33 56.9%	10 17.2%	2 3.4%	1 1.7%	-
5 I would like to keep the CAT system in my classroom.	36 62.1%	15 25.9%	5 8.6%	1 1.7%	1 1.7%	-

In the eight other assessed areas the percentage of teachers either supporting or strongly supporting the statements are impressive:

Statement	%
My students demonstrated an increased ability to follow directions when I used the CAT system	80.93
I feel that the CAT system improved my students' attention skills and helped hold their attention	84.21
I feel that the CAT system improved my ability to control and manage the classroom.	70.69
I experienced a decrease in the need to repeat directions and information (i.e. redirection and reinstruction).	74.14
My students benefited from using the microphone	76.92
The system was comfortable and easy to use on a daily basis.	93.10
I experienced less voice/vocal strain when using the CAT system.	75.86
I believe that using the CAT system had a positive effect on the students' overall achievement.	77.59

The reluctant talkers / very quiet EAL children really responded positively to using the microphone during Speaking and Listening sections of their lessons, particularly in 'interviewing' for science and literacy work.

Year 5 teacher, L.B. Camden

Many of the teachers involved in the research project during the first half of the year were using microphones that have since been superseded by smaller, lighter weight microphones. Even so, over 93 percent of all the teachers agreed that the system was comfortable and easy to use on a daily basis.

It would appear from the research study that teachers working in newly built schools where strict design specifications about the necessary acoustical qualities of the classrooms for effective teaching and learning were in force, were just as much in need of using the infrared system as were their colleagues teaching in schools built during the last century or earlier.

An excellent piece of equipment. The children that tend to not fully hear instructions as they sit at the back of the classroom were able to hear what was being said. After using the sound system I felt that my voice was quieter and that my throat was not sore.

Year 4 teacher, L.B. Hillingdon

Teachers recording levels of disagreement with the statements is very low overall with the percentage of teachers rising to more than 10 percent in disagreement only occurring once – "I felt more relaxed and less tired at the end of the teaching day when using the CAT system" (15.52%).

Two teachers, one primary and one secondary, consistently either somewhat disagreed or strongly disagreed with the value statements contained in the questionnaire and judged that the system did little or nothing to improve the teaching and learning environment in their classrooms. However, the primary school teacher wrote in the general comment section of her questionnaire that she judged that the system would be "better in a bigger room or with older children" and she recognized the value of her students using the microphone.

Study of the data tables reveals that, overall, teachers in primary schools were marginally more enthusiastic about the benefits of using the CAT system than were their secondary school teacher colleagues, in some areas by over 10 percent. However, this is a generalization as several individual secondary school teachers recorded some of the strongest support for the system.

Table 1b: Secondary Teacher Reponse Only

SCHOOLS: SECONDARY (7)

TEACHERS: 30

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
Student Behaviors						
1*My students were able to hear and understand me better when using the CAT system.	18 60.0%	8 26.7%	4 13.3%	-	-	-
2*I feel that using the CAT system helped improve the rate at which my students learned because they were able to listen and understand better.	8 27.6%	12 41.4%	7 24.1%	2 6.9%	-	1
3 My students demonstrated an increased ability to follow directions when I used the CAT system.	9 30.0%	13 43.3%	6 20.0%	2 6.7%	-	-
4 I feel that the CAT system improved my students' attention skills and helped hold their attention.	10 34.5%	13 44.8%	5 17.2%	1 3.4%	-	1
5 I feel that the CAT system improved my ability to control and manage the classroom.	7 23.3%	13 43.3%	9 30.0%	1 3.3%	-	-
6 I experienced a decrease in the need to repeat directions and information (i.e. redirection and reinstruction).	7 23.3%	13 43.3%	8 26.7%	2 6.7%	-	-
7 My students benefited from using the microphone	11 42.3%	7 26.9%	7 26.9%	1 3.8%	-	4
8 Students in the back of the room participated in class discussions more often because they could hear and understand better.	4 14.3%	13 46.4%	9 32.1%	2 7.1%	-	2
Teacher Perceptions						
1 The system was comfortable and easy to use on a daily basis.	18 60.0%	10 33.3%	1 3.3%	1 3.3%	-	-
2 I felt more relaxed and less tired at the end of the teaching day when I used the CAT system.	8 26.7%	10 33.3%	7 23.3%	4 13.3%	1 3.3%	-
3 I experienced less voice/vocal strain when using the CAT system.	13 43.3%	9 30.0%	5 16.7%	2 6.7%	1 3.3%	-
4* I believe that using the CAT system had a positive effect on the students' overall achievement.	4 13.3%	19 63.3%	5 16.7%	2 6.7%	-	-
5 I would like to keep the CAT system in my classroom.	16 53.3%	10 33.3%	3 10.0%	1 3.3%	-	-

Whilst to some extent speculation, and based in part on comments by teachers when helping them set up the equipment in their classrooms, the cause of this relatively small disparity in judgement might be related to the following:

- 1) there are more male teachers in secondary schools some of whom have powerful voices and believe that a soundfield system is not needed to ensure all pupils can hear them;
- 2) overall, the secondary school teachers were older and had been teaching longer than their primary school teacher colleagues and were perhaps more resistant to accepting the benefits of new technology or less inclined to modify their practice;
- 3) students in Key Stages 4 and 5 were less attracted to the system than younger pupils – possibly because they have developed the cognitive strategies to fill in the gaps when they miss words spoken by the teacher, i.e. making listening a less taxing activity. However, teachers of MFL reported strong support for the system when working with students in all Key Stages.

There are a series of other reasonable assumptions that can be drawn from the above data including:

- improved attention and ability to follow instructions by students as a result of hearing and understanding more easily results in faster progress and higher attainment;
- when less time is taken up in repeating information there is more time for students to engage in their individual or small group work, thereby making more progress in a lesson than would otherwise be the case. Teachers and classroom assistants have the time to provide more support when students are working;
- improved classroom control means less disruption, an improved working environment, more efficient use of lesson time and higher standards of work.

A number of teachers took the opportunity to add comments in their written responses. Some of the most supportive statements can be found in the margins throughout this report.

Any negative comments were mainly confined to recommending the development of a smaller and lighter weight microphone. This has now been developed and several teachers have now used the new microphone to good effect.

The system was an asset to my teaching. The whole experience made me realise exactly how much I misuse my voice on a regular basis.

Year 5 teacher, L.B.
Hillingdon

Data Analysis: Student Questionnaires

Analysis of the student comments reveals a strongly positive response to three of the seven statements, i.e. nearly two-thirds of all students judged that they could hear and understand their teacher better, that they were able to hear the instructions better and more clearly than in other similar class situations and that it would be beneficial to them if all of their classes used

Table 1c: Primary Teacher Responses Only

SCHOOLS: PRIMARY (6)

TEACHERS: 28

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
Student Behaviors						
1*My students were able to hear and understand me better when using the CAT system.	19 67.9%	8 28.6%	- -	1 3.6%	- -	- -
2*I feel that using the CAT system helped improve the rate at which my students learned because they were able to listen and understand better.	5 17.9%	20 71.4%	2 7.1%	1 3.6%	- -	- -
3 My students demonstrated an increased ability to follow directions when I used the CAT system.	11 39.3%	14 50.0%	2 7.1%	1 3.6%	- -	- -
4 I feel that the CAT system improved my students' attention skills and helped hold their attention.	13 46.4%	12 42.9%	2 7.1%	1 3.6%	- -	- -
5 I feel that the CAT system improved my ability to control and manage the classroom.	8 28.6%	13 46.4%	5 17.9%	2 (7.1%)	- -	- -
6 I experienced a decrease in the need to repeat directions and information (i.e. redirection and reinstruction).	12 42.9%	11 39.3%	4 14.3%	1 3.6%	- -	- -
7 My students benefited from using the microphone	15 57.7%	7 26.9%	4 15.4%	- -	- -	2 -
8 Students in the back of the room participated in class discussions more often because they could hear and understand better.	10 35.7%	9 32.1%	9 32.1%	- -	- -	- -
Teacher Perceptions						
1 The system was comfortable and easy to use on a daily basis.	17 60.7%	9 32.1%	2 7.1%	- -	- -	- -
2 I felt more relaxed and less tired at the end of the teaching day when I used the CAT system.	7 25.0%	11 39.3%	6 21.4%	3 10.7%	1 3.6%	- -
3 I experienced less voice/vocal strain when using the CAT system.	12 42.9%	10 35.7%	4 14.3%	1 3.6%	1 3.6%	- -
4*I believe that using the CAT system had a positive effect on the students' overall achievement.	8 28.6%	14 50.0%	5 17.9%	- -	1 3.6%	- -
5 I would like to keep the CAT system in my classroom.	20 71.4%	5 17.9%	2 7.1%	- 3.6%	1 -	- -

Table 2a: Combined total of all student responses

SCHOOLS: ALL (13)

STUDENTS: 554

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
1 I was able to hear and understand my teacher better when using the CAT system.	243 44%	144 26%	118 21%	27 5%	20 4%	2 0%
2 I feel that using the CAT system helped me improve the rate at which I learned phonics because I was able to listen and understand better.	143 26%	141 25%	154 28%	68 12%	43 8%	5 1%
3 I feel that I was able to hear the instructor better and more clearly than in other similar class situations.	233 42%	144 26%	105 19%	42 8%	29 5%	1 0%
4 I feel that my English skills improved more because I could hear the teacher better.	141 25%	117 21%	123 22%	88 16%	75 14%	10 2%
5 My confidence improved because everyone else could hear me better when I used the student microphone.	140 25%	79 14%	124 22%	63 11%	91 16%	57 10%
6 I achieved better grades because the classroom amplification system allowed me to hear the teacher more clearly.	126 23%	106 19%	136 25%	70 13%	86 16%	30 5%
7 It would be beneficial to me if all of my classes used classroom amplification systems.	227 41%	126 23%	101 18%	36 6%	59 11%	5 1%

The children benefit from the CAT system particularly when instructions are being given for lessons. They enjoy lessons when the CAT is being used.

Year 3 teacher, L.B. Hillingdon

CAT systems.

Whilst recording lower levels of agreement with the remaining statements, 39% being the lowest in relation to students experiencing an improvement in their confidence as a result of using the handheld microphone, the results provide a strong endorsement of the benefits students believe having the system in their classrooms provides.

Overall, primary school students recorded stronger approval for the benefits of the system than did secondary students. In two of the three statements quoted above, primary school students recorded approval rates of over 70 per cent. This discrepancy in judgement confirmed the feedback drawn from researcher contact with students from both primary and secondary schools. Students in Years 10-13 (15-19 year olds) were less impressed with the benefits of the system than were their younger secondary colleagues in Years 7-9. More highly developed cognitive skills at 15 years of age and above would appear to result in older students not recognising the impact of the equipment on their learning to the extent that it did for their younger secondary school colleagues and students in primary schools. However, even here only 6 per cent of secondary school students disagreed with the statement that they were able to hear and understand their teacher better when using the CAT system.

Outright disagreement by all students with statements was relatively low, 9% being the lowest and 30% the highest.

Table 2b: Secondary student responses only

SCHOOLS: SECONDARY (7)

STUDENTS: 159

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
1 I was able to hear and understand my teacher better when using the CAT system.	52 33%	58 36%	39 25%	6 4%	3 2%	1 1%
2 I feel that using the CAT system helped me improve the rate at which I learned phonics because I was able to listen and understand better.	26 16%	48 30%	53 33%	17 11%	14 9%	1 1%
3 I feel that I was able to hear the instructor better and more clearly than in other similar class situations.	42 26%	52 33%	45 28%	12 8%	7 4%	1 1%
4 I feel that my English skills improved more because I could hear the teacher better.	20 13%	33 21%	46 29%	32 20%	22 14%	6 4%
5 My confidence improved because everyone else could hear me better when I used the student microphone.	23 14%	21 13%	35 22%	25 16%	29 18%	26 16%
6 I achieved better grades because the classroom amplification system allowed me to hear the teacher more clearly.	25 16%	43 21%	52 33%	26 16%	19 12%	3 2%
7 It would be beneficial to me if all of my classes used classroom amplification systems.	49 31%	39 25%	43 27%	11 7%	17 11%	0 0%

Table 2c: Primary Student Responses Only

SCHOOLS: PRIMARY (6)

STUDENTS: 395

Statement	Strongly agree	Somewhat agree	Neutral	Somewhat disagree	Strongly disagree	N/A
1 I was able to hear and understand my teacher better when using the CAT system.	191 48%	86 22%	79 20%	21 5%	17 4%	1 0%
2 I feel that using the CAT system helped me improve the rate at which I learned phonics because I was able to listen and understand better.	117 30%	93 24%	101 26%	51 13%	29 7%	4 1%
3 I feel that I was able to hear the instructor better and more clearly than in other similar class situations.	191 48%	92 23%	60 15%	30 8%	22 6%	0 0%
4 I feel that my English skills improved more because I could hear the teacher better.	121 31%	84 21%	77 19%	56 14%	53 13%	4 1%
5 My confidence improved because everyone else could hear me better when I used the student microphone.	117 30%	58 15%	89 23%	38 10%	62 16%	31 8%
6 I achieved better grades because the classroom amplification system allowed me to hear the teacher more clearly.	101 26%	72 18%	84 21%	44 11%	67 17%	27 7%
7 It would be beneficial to me if all of my classes used classroom amplification systems.	178 45%	87 22%	58 15%	25 6%	42 11%	5 1%

Conclusion

It is unusual in a research study to find such strong support for statements designed by researchers. What the research has shown very clearly is that for the large majority of learners the placement of an infrared soundfield audio system has brought considerable benefits including:

- improved behaviours conducive to effective learning;
- improved attainment and rates of progress;
- improved listening skills and understanding of teacher instructions;
- improved on-task behaviour;
- improved ability to follow directions;
- less disruptive behaviour;
- improved self-confidence when speaking to the whole class.

For teachers, the key benefits of the system were judged to have been:

- less repetition of instructions;
- less vocal fatigue and tiredness;
- improved ability to hear accurately what pupils were saying when using the microphone and provide appropriate support where necessary;
- improved ability to control and manage the class;
- more time to support individual and small groups of learners.

From this evidence it would appear that in the design of any new school building or refurbishment of an existing building serious consideration should be given to incorporating classroom soundfield audio systems in order to ensure the best possible teaching and learning environments are created with the once in a lifetime level of capital funding that is available at the moment in the BSF and PCP initiatives. Whilst the learning needs of all students is enhanced where the system is installed, for the significant number of students with differing levels of hearing impairment, ranging from short term minor to permanent severe, it is all the more essential that all classroom learning environments are enhanced by the installation of a soundfield audio system.

Acknowledgements

I would like to thank all the primary and secondary school headteachers who agreed to take part in the study and the teaching staff who conscientiously used the equipment on a daily basis and returned completed questionnaires. I would also like to thank the many children that completed and returned study questionnaires. Without the cooperation of both teachers and students then insufficient data and comment would have been available for analysis.

This study could not have been carried out without the generous support of Lightspeed Technologies. The America-based company provided the many portable Redcat classroom soundfield audio units required to secure feedback from a sufficiently large number of teachers and students to ensure a robust research project could be completed in the Academic Year 2008-9.

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