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## Research study into the impact of the Flexcat classroom audio distribution system

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## Executive Summary

Over the second half of 2016, eight teachers in six secondary schools in England and Scotland undertook an action research study of Lightspeed Technology's Flexcat classroom audio distribution (FCAD) system. The system is designed specifically to support small-group collaborative working, now recognized as one of the major strategies to secure effective student learning. The research focused on getting teacher and student feedback on the extent to which having the FCAD system enhanced learning outcomes, the management of group collaborative working, the use of lesson time, and the use of all available learning spaces.

The Flexcat allows teachers and students to speak clearly and intelligibly to the whole class when appropriate. It also enables teachers to unobtrusively monitor and assess the quality of conversations of up to 12 small, collaborative, problem-solving student groups; to intervene to support a student or whole group when necessary; and to enter into conversation with the group without disturbing other neighboring student groups. The technology allows students who need help to attract the teacher's attention when needed without having to put up their hands or call across the classroom. Teachers can also place students outside the main learning space and remain in two-way contact with them.

This report contains collated tables of data drawn from evaluation forms completed by eight teachers and 111 students. Analysis of this data, together with evidence drawn from verified lesson observation reports, school manager feedback, teacher and school manager interviews, and classroom video evidence, provides the basis for the judgements and conclusions presented in this report.

The data provides clear evidence that using a Flexcat system in schools delivers a wide range of significant benefits. These benefits, as identified by teachers and students, include:

- Improved acoustic accessibility in all teaching spaces (however old, new, small, or large) and independent of the quality of the teachers' or students' voices;
- Reduction in lesson time wasted through:
  - not having to repeat information;
  - gaining student attention immediately when moving between whole-class and small-group collaborative learning; and
  - students securing teacher support as soon as it is needed;
- Improved levels of student on-task behavior;
- Improved teacher understanding of what students were capable of contributing to group problem-solving discussions through discrete monitoring of conversations;
- Improved quality of teacher intervention to support students based on improved knowledge of student capability;
- Improved assessment and support of students with all levels of SEN;
- Increased teacher confidence in giving time to small-group collaborative work and in placing students outside the main classroom, knowing that two-way communication remained available;
- Improved student enjoyment of lessons; and
- Reduction in teacher vocal strain and tiredness.

While these were the main benefits, two drawbacks were identified by some of the teachers and students:

- The time and effort needed to move multi-unit systems to alternative classrooms for different groups of students and for use by different teachers; and
- The managing of some students who took time to get over the novelty of the technology and other students who were uncomfortable that the teacher could unobtrusively listen into their group discussions.

Most significantly, no inadequacy in the effectiveness of the Flexcat in supporting groups of students in collaborative problem-solving activity was identified by any of the eight teachers.

Overall, the benefits identified clearly outweigh the drawbacks, although further decreasing the weight and size of the equipment will improve the chances of the technology being used on a regular basis.

## Introduction

Lightspeed Technologies is a company based in Oregon, USA, that for more than 20 years has specialized in the development and production of classroom audio distribution (CAD) systems designed initially to improve speech intelligibility in classrooms to support effective teaching and learning. More recently, CAD systems have been used to enhance the management and quality of effective small-group collaborative learning.

The original CAD systems significantly improved acoustic accessibility, enabling children and young people to hear and understand what their teachers and peers were saying no matter what the quality of their voices or the quality of the students' hearing. Previous classroom-based action research<sup>1</sup> has shown that where this improvement in speech intelligibility has been achieved, it has resulted in improved student on-task behavior and attainment, especially for hearing-impaired and other SEN and EAL students. Six years ago, the company began to receive feedback from schools that while their systems improved the quality of whole-class teaching and learning, lesson time was increasingly being devoted to small-group collaborative working and that teachers needed technology that would allow them to more effectively support their students when working in this way.

As a result, the company undertook research into how its CAD system could be developed to provide the support requested by teachers. The outcome was the development of the Flexcat system. It incorporates Redcat (CAD) technology that delivers improved speech intelligibility with a set of as many as 12 wirelessly connected small pods, each containing a speaker and microphone. The pods can be distributed around groups of students wherever they are, within or outside the learning space. The teacher's microphone has an earpiece attachment through which the teacher can listen to the student voices picked up by the microphone in each pod.

A handheld remote control or iOS app allows the teacher to switch between the pods, activating the speaker in the pod to allow two-way discussion between the teacher and the group of students and to link the pod speaker to the main Redcat speaker so that individual students can speak intelligibly to the whole class. Small groups of students can also be set to work in neighboring spaces outside the classroom while maintaining contact with the teacher through the use of the pod system. If students needing help wish to attract the attention of the teacher, they can activate a button on the side of the pod that triggers a visual signal on the teacher's remote control and an aural signal through the earpiece so the teacher can respond immediately.

The technology is designed to support the teacher in managing small-group collaborative activity by allowing the teacher to:

- Address the whole class when introducing the lesson, at various points in the lesson when the teacher needs to talk to all students, and at the end of a lesson when reviewing the lesson and pulling together the learning outcomes achieved and next steps;
- Discretely listen through the earpiece to monitor and assess the quality and authenticity of individual contributions to small-group discussions through activation of the pod's microphone;
- Intervene, when necessary, to praise, support, encourage, or challenge individuals or whole groups through activation of the pod's speaker, without distracting other groups or needing to walk over to the group;
- Allow students to clearly share their ideas and report on progress to the whole class by linking the pod's microphone output signal to the Redcat speaker; and to
- Place groups of students in all parts of the available learning space, including spaces adjacent to the classroom such as corridors or neighboring classrooms, without losing direct contact.

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<sup>1</sup> Ray, H. Revalidations Submission: Project MARRS. WOVSED, P.O. Box E, Norris City, IL 62869. Resubmitted to National Diffusion Network, 1992.

Smaldino, J. and Flexer, C. (ed.) (2012) Handbook of Acoustic Accessibility: Best Practices for Listening, Learning and Literacy in the Classroom. New York: Thieme Medical Publishers (ISBN 978-1-60406-765-1)

Preston, C., Younie, S. and Turner, R. (2015) [Listening to Learn: An Evaluation of Classroom Audio Distribution Technology for Enriching Teaching and Learning](#). A MirandaNet Fellowship publication in association with Lightspeed Technologies.

Dockrell, J. E. and Shield, B (2012). "The impact of sound-field systems on learning and attention in elementary school classrooms." J Speech Lang Hear Res 55(4): 1163-1176.

Students are supported when working in small groups by knowing that they can make instant contact with the teacher should they need help by activating the pod's call button. They are also able stay in voice contact with the teacher when working outside the main teaching and learning space.

So far, the Flexcat technology has gone through three stages of technical development, with modifications and improvements incorporated in response to the feedback from earlier classroom-based trials of the systems. This research report is focussed on the results drawn from six secondary schools (see Appendix A) that implemented the 3<sup>rd</sup> version of the system during 2016.

A total of eight teachers have taken part in the research project by completing and submitting detailed evaluation reports for collation and analysis (see Table 1). A total of seven classes of students have completed and submitted detailed evaluation forms for analysis (see Table 2). While teachers were encouraged to shape the nature of the research trial to suit their particular circumstances and interests, they were tasked with using all aspects of the system in order to provide the lead researcher with as much information on the effectiveness of the system as possible. The lead researcher also undertook regular visits to the schools to observe and record (see Appendix B) how the teachers and students used the technology during lessons to support teaching and learning. Debriefing discussions with teachers occurred regularly after observations. First draft observation reports written by the lead researcher were subsequently sent to the teachers to validate the accuracy of the content and to add information where relevant.

Five of the six schools involved in the study were either recently built or included new or refurbished buildings. The location of the Flexcats differed according to the design of the schools. The majority of Flexcat placements were in traditional, average-sized, discrete classrooms with varying standards of acoustics ranging from just about satisfactory in the one school soon to be demolished and replaced with a new build, to very good in a building with appropriate acoustic materials installed. In two schools where large open-plan classrooms were the norm, the equipment was deployed to support the teaching and learning of larger-than-average-sized groups of students where multiple classes were often being taught. Students in these larger spaces experienced varying degrees of difficulty in consistently hearing speech clearly prior to the installation of the Flexcat, as a result of the distance the student might be at times from the teacher or other student, the quality of the teacher's voice, or noise infiltration from other classes being taught in the space.

Following intensive training in the use of the technology, three of the teachers used the system throughout the summer term and the first half of the autumn term 2016. The remainder did not start to use the Flexcat until late on in the summer term or two to three weeks into the autumn term. In the two schools where two teachers piloted the Flexcat, it was necessary to move the Flexcat system between their classrooms.

Towards the end of the research trial period, eight teachers and one hundred and eleven students completed detailed evaluation forms. The teacher evaluation form comprised 20 statements against which the teacher recorded their level of agreement or disagreement and five questions that teachers were encouraged to answer in as much detail as possible. The student evaluation form comprised eight statements and one question.

## **Data Collation**

The findings contained in this report are drawn from a variety of data, including completed teacher and student evaluations, recorded and validated lesson observations, post-lesson discussions with teachers and managers, recorded interviews, and video data.

What follows is a set of two data tables. The first is a collation of the responses recorded by the eight teachers and the second records the collated data from the 111 student responses.

**Table 1**

**FLEXCAT AUDIO DISTRIBUTION ACTION RESEARCH STUDY  
COLLATED TEACHER POST-STUDY EVALUATIONS**

**SCHOOLS: 6**

**TEACHERS: 8**

| Statement |                                                                                                                                                                   | Strongly Agree | Somewhat Agree | Neutral      | Somewhat Disagree | Strongly Disagree | N/A |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|--------------|-------------------|-------------------|-----|
| <b>1</b>  | My students were able to hear and understand me better when using the Flexcat system.                                                                             | 5<br>(62.5%)   | 3<br>(37.5%)   |              |                   |                   |     |
| <b>2</b>  | The Flexcat helped me improve classroom management by keeping students engaged and on task while working in small groups.                                         | 1<br>(12.5%)   | 3<br>(37.5%)   | 2<br>(25.0%) | 2<br>(25.0%)      |                   |     |
| <b>3</b>  | It was easier for me to deliver a differentiated curriculum to my collaborative learning groups when using the Flexcat.                                           | 1<br>(12.5%)   | 2<br>(25.0%)   | 4<br>(50.0%) | 1<br>(12.5%)      |                   |     |
| <b>4</b>  | I experienced a decrease in the need to repeat directions and information, allowing me to cover more material in a lesson when I use the Flexcat.                 | 2<br>(25.0%)   | 6<br>(75.0%)   |              |                   |                   |     |
| <b>5</b>  | The Flexcat allowed me to give more intensive support to one group while remaining aware of progress in all groups.                                               | 2<br>(25.0%)   | 4<br>(50.0%)   | 1<br>(12.5%) |                   | 1<br>(12.5%)      |     |
| <b>6</b>  | My students were less disturbed when I used the Flexcat to talk to one group.                                                                                     | 1<br>(12.5%)   | 3<br>(37.5%)   | 1<br>(12.5%) | 3<br>(37.5%)      |                   |     |
| <b>7</b>  | I was able to assess more easily, accurately, and at a deeper level how my students were coping with tasks and achieving desired outcomes when using the Flexcat. | 2<br>(25.0%)   | 6<br>(75.0%)   |              |                   |                   |     |
| <b>8</b>  | The Flexcat allowed me to unobtrusively witness the level and usefulness of contributions students make to small-group discussions, including the normally shy.   | 5<br>(62.5%)   | 3<br>(37.5%)   |              |                   |                   |     |
| <b>9</b>  | I was better able to understand and respond to the needs of my students by providing better-informed feedback when I used the Flexcat.                            | 1<br>(12.5%)   | 4<br>(50.0%)   |              | 3<br>(37.5%)      |                   |     |

**Table 1 - Continued**

| Statement |                                                                                                                                                                                           | Strongly Agree | Somewhat Agree | Neutral      | Somewhat Disagree | Strongly Disagree | N/A |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------|----------------|--------------|-------------------|-------------------|-----|
| 10        | My use of the Flexcat helped improve my students' quality of work and discussion during small-group activity.                                                                             | 1<br>(12.5%)   | 5<br>(62.5%)   |              | 1<br>(12.5%)      | 1<br>(12.5%)      |     |
| 11        | My use of the Flexcat helped students of all abilities to complete work more quickly and achieve higher standards.                                                                        | 1<br>(12.5%)   | 3<br>(37.5%)   | 3<br>(37.5%) | 1<br>(12.5%)      |                   |     |
| 12        | My students benefited from using the Flexcat pod to talk to me and to the whole class                                                                                                     | 2<br>(28.6%)   | 5<br>(71.4%)   |              |                   |                   | 1   |
| 13        | My use of the Flexcat resulted in my students enjoying their learning more.                                                                                                               | 3<br>(37.5%)   | 3<br>(37.5%)   | 1<br>(12.5%) | 1<br>(12.5%)      |                   |     |
| 14        | Improved formative assessment as a result of using the Flexcat meant that I could plan with greater confidence and accuracy what the next steps were in learning for each of my students. |                | 1<br>(14.3%)   | 4<br>(57.1%) | 2<br>(28.6%)      |                   | 1   |
| 15        | Improved small-group learning positively influenced whole-class learning.                                                                                                                 | 3<br>(42.9%)   | 3<br>(42.9%)   | 1<br>(14.3%) |                   |                   | 1   |
| 16        | The Flexcat has inspired innovation in teaching and learning in my classroom.                                                                                                             | 1<br>(12.5%)   | 3<br>(37.5%)   | 4<br>(50.0%) |                   |                   |     |
| 17        | The Flexcat has helped me make better use of the available learning spaces inside and outside my classroom                                                                                | 2<br>(33.3%)   | 2<br>(33.3%)   | 1<br>(16.7%) |                   | 1<br>(16.7%)      | 11  |
| 18        | I experienced less voice/vocal strain when using the Flexcat system.                                                                                                                      | 5<br>(62.5%)   | 2<br>(25.0%)   | 1<br>(12.5%) |                   |                   |     |
| 19        | The Flexcat equipment was simple and easy for me to use.                                                                                                                                  | 2<br>(25.0%)   | 4<br>(50.0%)   |              | 2<br>(25.0%)      |                   |     |
| 20        | I would like to use the Flexcat on a regular basis.                                                                                                                                       | 3<br>(37.5%)   | 2<br>(25.0%)   | 1<br>(12.5%) | 2<br>(25.0%)      |                   |     |

**Question #1: What have been the greatest advantages for you in having a Flexcat system in the classroom?**

**Responses:**

There were two really key advantages:

- Firstly, the audibility of my explanations was greatly advanced and the students were able to hear everything clearly. This saved me having to repeat myself, and the students were able to focus more easily because they weren't having to strain to hear.
- Secondly, it was really great being able to walk around the room and even leave the room and be able to hear individuals speaking to each other, in particular when training new staff or listening to students who I know were finding a topic tricky and were too shy to tell me directly.

Being better able to gauge how pupils were coping with the work and how much of a contribution each pupil was making.

The sound system is much better and students enjoy small discussion in their groups knowing that I am listening to their ideas. Students don't get disrupted during lesson, when speaking to any other groups through the use of pods allowed me to give more intensive support to one group while remaining aware of progress in all groups.

Allowing more small groups to work.

Sending a small group of students outside the classroom to work.

Teaching in a learning base, the main speaker provides an invaluable resource to speak to the group as a whole. I am able to speak more calmly, providing a better learning environment and one more conducive to learning.

I teach in open learning spaces with other classes and there can be a lot of background noise. This helped the class hear me better, and I could hear them respond.

**Question #2: What have been the greatest disadvantages for you in having a Flexcat system in the classroom?**

**Responses:**

The greatest disadvantage was the sheer size of the equipment. This meant that if I needed to teach in another classroom, I couldn't just transport it round there easily. It was also frustrating if I had put it away for the weekend (due to schools being rented for other companies) and putting it out again on Monday and needing to charge it briefly. It was fairly quick to charge, but this was still something to organize in advance or wait for. Sometimes I overheard really insightful questions and it would have been so helpful to record these conversations – the ability to record would be a really good addition in future.

Only having six pods when I have eight groups in my class.

Because of the various different classes, sometimes it does take time to set up the Flexcat.

Overload of information.

A lot of distraction. Too much equipment to move from one classroom to another.

Monitoring of conversations in Science has some value using Flexcat, but often the microphones do not pick up the group. This can be due to the seating arrangement in the learning base. Pupils become aware of when the teacher is listening, so often this causes disruption or changes the natural flow of the discussion occurring.

It is more of a distraction as the students like different things; they couldn't help playing with it.

The disadvantages have been only having the one Flexcat system in school. This, of course, has meant that the equipment has to be set up to be readily available for the lesson. This can be time-consuming. Having a system that was fixed to a class, so if part of the Flexcat could be attached to the wall to enhance the quality of the system, would be great.



**Question #3: What have been the greatest advantages for your students in having a Flexcat system in the classroom?**

**Responses:**

The pupils originally love the gimmicky novelty of the Flexcat and I overheard them saying things like “Yay, I love these lessons with this (Flexcat).” Having this positive start meant that they warmed to it very quickly and I didn’t need to encourage them to get used to it. The pupils both were able to unselfconsciously speak and be heard even if I was not near, but they were also aware that I might hear them at any time, so their conversations tended to remain on task. Best of all, sometimes I had no idea how insightful their thoughts were (often under their breath or suggesting something to a friend) and it was so good to be able to hear these. Sometimes the pupils had the opportunity to use the audio equipment themselves and listen to each other. This was surprisingly useful as they realized how hard they were each working. When the pupils were listening, the others were also more on task because they knew a peer was listening.

Giving more opportunities to ask for help or clarification without attracting the attention of the whole class.

The students found it easier to ask questions because they know that the teacher is listening and other students in the class don’t know about it. Students enjoy small discussion in their groups knowing that I am listening to their ideas.

Allowing shy students to share ideas.

Hearing very quiet students talking and allowing them to share.

Pupils are better aware of instructions and explanations during a lesson. When sharing ideas with the class they can be heard if speaking directly into one of the pods. Pupils are able to ask questions and get feedback more quickly using the call button.

They didn’t have to repeat themselves when answering a question. They could buzz me for help.

The greatest advantage is that you are able to monitor students’ learning with the use of the remote and therefore do not have to physically go up to them to see if that student is on track. You can also listen in on conversations to ensure all students are on target and are having effective conversations in the classroom.

**Question #4: What have been the greatest disadvantages for your students in having a Flexcat system in the classroom?**

**Responses:**

Probably the greatest disadvantage for them was the time it took me to learn how to use it! This sometimes took some time to remember how to use each function. Otherwise the students were not disadvantaged from having it in the classroom.

Not aware of any.

Sometimes the students use the call button without actually having a go at answering the question.

Distracted by the equipment

Very distracted. Some felt embarrassed I could hear them.

I do not believe there any disadvantages to the system. I believe there could be improvements in the pickup of the microphone in the pod and if the speaker’s voice came out of all the pods rather than the main speaker.

Students did not like the idea that they were being listened in on and this took quite some time to get used to.

| <b>Question #5: Were there any particular children that benefited from the use of the Flexcat?</b>                                                                                                                                                                                                                                                         |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Responses:</b>                                                                                                                                                                                                                                                                                                                                          |
| Yes, the shy students who don't normally get heard definitely felt more listened to, especially when I drew attention to things they had said when they hadn't even realized I had been listening.                                                                                                                                                         |
| Hearing-impaired pupils and lower-ability pupils who also lacked confidence.                                                                                                                                                                                                                                                                               |
| EAL students, those with hearing aids, and those who are normally shy in lessons. Students benefited from using the Flexcat pod to talk to me and to the whole class.                                                                                                                                                                                      |
| Shy EAL students                                                                                                                                                                                                                                                                                                                                           |
| Very quiet students and ones who work well outside independently                                                                                                                                                                                                                                                                                           |
| A number of pupils have benefitted from using this system over the research cycle, particularly very quiet and shy pupils who find asking for help or raising a hand difficult in a social situation. The pods have been used by one severely confidence-lacking pupil to enable constant support and feedback if needed in a large teaching-base setting. |
| Shy students could still speak quietly but be heard. Everyone could hear what everyone was saying.                                                                                                                                                                                                                                                         |

**Table 2**

**FLEXCAT AUDIO DISTRIBUTION ACTION RESEARCH STUDY  
COLLATED STUDENT POST-STUDY EVALUATIONS**

**SCHOOLS: 6**

**STUDENTS: 111**

| <b>Statement #1: I was able to hear and understand my teacher better when the Flexcat was used.</b> |              |               |               |                                |
|-----------------------------------------------------------------------------------------------------|--------------|---------------|---------------|--------------------------------|
| <b>1<br/>Least in agreement</b>                                                                     | <b>2</b>     | <b>3</b>      | <b>4</b>      | <b>5<br/>Most in agreement</b> |
| 1                                                                                                   | 7            | 4             | 3             | 7                              |
| 0                                                                                                   | 0            | 1             | 2             | 2                              |
| 0                                                                                                   | 0            | 6             | 8             | 4                              |
| 1                                                                                                   | 0            | 6             | 0             | 2                              |
| 0                                                                                                   | 0            | 12            | 3             | 11                             |
| 1                                                                                                   | 4            | 4             | 4             | 5                              |
| 0                                                                                                   | 0            | 2             | 6             | 5                              |
| 3<br>(2.7%)                                                                                         | 11<br>(9.9%) | 35<br>(31.5%) | 26<br>(23.4%) | 36<br>(32.4%)                  |

Table 2 - Continued

| Statement #2: I was able to settle to work more quickly because I heard the lesson introduction clearly the first time. |               |               |               |                        |
|-------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                                                                 | 2             | 3             | 4             | 5<br>Most in agreement |
| 1                                                                                                                       | 6             | 6             | 4             | 5                      |
| 0                                                                                                                       | 0             | 0             | 3             | 2                      |
| 0                                                                                                                       | 1             | 2             | 8             | 7                      |
| 1                                                                                                                       | 3             | 1             | 4             | 0                      |
| 0                                                                                                                       | 4             | 3             | 10            | 9                      |
| 3                                                                                                                       | 5             | 8             | 0             | 2                      |
| 0                                                                                                                       | 1             | 0             | 3             | 9                      |
| 5<br>(4.5%)                                                                                                             | 20<br>(18.0%) | 20<br>(18.0%) | 32<br>(28.8%) | 34<br>(30.6%)          |

| Statement #3: My group remained more on task when the Flexcat was used as the teacher could listen to see if we were working effectively and give help when necessary. |               |               |               |                        |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                                                                                                                | 2             | 3             | 4             | 5<br>Most in agreement |
| 0                                                                                                                                                                      | 1             | 8             | 8             | 5                      |
| 0                                                                                                                                                                      | 0             | 2             | 2             | 1                      |
| 0                                                                                                                                                                      | 2             | 4             | 9             | 3                      |
| 1                                                                                                                                                                      | 3             | 1             | 3             | 1                      |
| 2                                                                                                                                                                      | 4             | 10            | 3             | 7                      |
| 3                                                                                                                                                                      | 5             | 6             | 3             | 1                      |
| 0                                                                                                                                                                      | 0             | 0             | 2             | 11                     |
| 6<br>(5.4%)                                                                                                                                                            | 15<br>(13.5%) | 31<br>(27.9%) | 30<br>(27.0%) | 29<br>(26.1%)          |

Table 2 - Continued

| Statement #4: I was less distracted when the teacher was talking to other groups. |               |               |               |                        |
|-----------------------------------------------------------------------------------|---------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                           | 2             | 3             | 4             | 5<br>Most in agreement |
| 2                                                                                 | 3             | 5             | 9             | 3                      |
| 0                                                                                 | 1             | 0             | 0             | 3                      |
| 1                                                                                 | 2             | 4             | 5             | 6                      |
| 0                                                                                 | 1             | 6             | 1             | 1                      |
| 3                                                                                 | 1             | 11            | 0             | 11                     |
| 4                                                                                 | 6             | 3             | 3             | 2                      |
| 0                                                                                 | 1             | 2             | 4             | 6                      |
| 10<br>(9.0%)                                                                      | 15<br>(13.5%) | 31<br>(27.9%) | 22<br>(19.8%) | 32<br>(28.8%)          |

| Statement #5: It was helpful to hear myself and/or other students speaking to the whole class through the Flexcat pod. |              |               |               |                        |
|------------------------------------------------------------------------------------------------------------------------|--------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                                                                | 2            | 3             | 4             | 5<br>Most in agreement |
| 0                                                                                                                      | 4            | 7             | 7             | 4                      |
| 0                                                                                                                      | 0            | 0             | 1             | 4                      |
| 0                                                                                                                      | 0            | 9             | 5             | 4                      |
| 0                                                                                                                      | 0            | 4             | 4             | 1                      |
| 0                                                                                                                      | 1            | 2             | 5             | 18                     |
| 4                                                                                                                      | 5            | 2             | 5             | 2                      |
| 1                                                                                                                      | 0            | 4             | 4             | 4                      |
| 5<br>(4.5%)                                                                                                            | 10<br>(9.0%) | 28<br>(25.2%) | 31<br>(27.9%) | 37<br>(33.3%)          |

Table 2 – Continued

| Statement #6: My confidence improved because everyone else could hear me better when I used the Flexcat pod. |               |               |               |                        |
|--------------------------------------------------------------------------------------------------------------|---------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                                                      | 2             | 3             | 4             | 5<br>Most in agreement |
| 3                                                                                                            | 4             | 5             | 6             | 4                      |
| 0                                                                                                            | 0             | 1             | 1             | 3                      |
| 1                                                                                                            | 4             | 9             | 1             | 3                      |
| 0                                                                                                            | 3             | 3             | 3             | 0                      |
| 2                                                                                                            | 3             | 8             | 6             | 7                      |
| 7                                                                                                            | 2             | 6             | 1             | 2                      |
| 1                                                                                                            | 1             | 2             | 5             | 4                      |
| 14<br>(12.6%)                                                                                                | 17<br>(15.3%) | 34<br>(30.6%) | 23<br>(20.7%) | 23<br>(20.7%)          |

| Statement #7: I enjoyed my lessons more when the Flexcat was used. |               |               |               |                        |
|--------------------------------------------------------------------|---------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                            | 2             | 3             | 4             | 5<br>Most in agreement |
| 1                                                                  | 4             | 6             | 1             | 10                     |
| 0                                                                  | 0             | 1             | 1             | 3                      |
| 0                                                                  | 2             | 7             | 6             | 3                      |
| 1                                                                  | 0             | 6             | 1             | 1                      |
| 0                                                                  | 1             | 7             | 1             | 17                     |
| 1                                                                  | 5             | 5             | 4             | 3                      |
| 0                                                                  | 0             | 1             | 3             | 9                      |
| 3<br>(2.7%)                                                        | 12<br>(10.8%) | 33<br>(29.7%) | 17<br>(15.3%) | 46<br>(41.4%)          |

Table 2 – Continued

| Statement #8: It would be beneficial to me if a Flexcat system were used in all of my classes. |              |               |               |                        |
|------------------------------------------------------------------------------------------------|--------------|---------------|---------------|------------------------|
| 1<br>Least in agreement                                                                        | 2            | 3             | 4             | 5<br>Most in agreement |
| 1                                                                                              | 4            | 6             | 8             | 3                      |
| 0                                                                                              | 0            | 0             | 2             | 3                      |
| 0                                                                                              | 1            | 9             | 4             | 4                      |
| 1                                                                                              | 1            | 6             | 0             | 1                      |
| 1                                                                                              | 1            | 5             | 10            | 9                      |
| 6                                                                                              | 3            | 5             | 0             | 4                      |
| 2                                                                                              | 0            | 1             | 2             | 8                      |
| 11<br>(9.9%)                                                                                   | 10<br>(9.0%) | 32<br>(28.8%) | 26<br>(23.4%) | 32<br>(28.8%)          |

|                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                               |
|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>Question #1: How did you feel about your teacher being able to listen into your group conversations?</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| <b>Responses: 102 of the 111 students gave responses. Of these:</b>                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                           |
| 20 (19.6%) students expressed unhappiness in the teacher being able to listen into group conversations;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| “I felt like my privacy was invaded” Y11<br>“Noisy & uncomfortable” Y11                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                       |
| 7 (6.9%) students expressed both positive and negative reactions;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                             |
| “Not good but it is easy to hear when other people are talking.”<br>“When the teacher uses the Flexcat I find it slightly creepy but with it everyone is always on task and concentrating.” Y8                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
| 14 (13.7%) judged that the Flexcat was okay;                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                  |
| “It was alright, I guess.” Y10<br>“It didn’t bother me.” Y9                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| 61 (59.8%) students gave positive judgments on their experience of the use of the Flexcat in their lessons.                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |
| “It really helps as the teacher can keep us on-task and make sure we are not messing around so a lot more work gets done.” Y7<br>“It helped me improve my scientific knowledge, due to the help that was provided when my teacher intervened and participated in the group discussion.” Y10<br>“It was useful as our teacher was able to give feedback to each group without needing to stop the whole class.” Y7<br>“I liked it as it made me feel excited as the teacher could hear all my ideas.” Y7<br>“I felt confident that my teacher could hear my opinion and thoughts on the work.” Y11<br>“I felt really confident because by using the Flexcat everyone is more focused and working harder.” Y7<br>“I think it is really good because there are some people who always talk about other things and disturb us” Y7<br>“It helped if we weren’t sure of an answer or a question to understand better rather than sit and struggle.” Y9<br>“I felt like I can finally be heard because usually I would always be annoyed when people would start talking and won’t let me speak.” Y7 |

**Data Analysis  
Teacher Evaluations  
Statements**

The three statements (1, 4, and 18) most closely associated with the original CAD characteristics of the Redcat speaker all produced results that reflected the findings found in previous research on the Redcat system: virtually 100% of the teachers agreed that their students were able to hear and understand them better when they used the Flexcat system, that they experienced a decrease in the need to repeat directions and information so they could cover more material in a lesson, and that they experienced less voice/vocal strain. It is notable that some of the teachers who made these judgements were working in classrooms with very good acoustic features but still recognized further improvement in speech intelligibility.

When looking at the evaluative statements that specifically related to the Flexcat, a wide variation of judgements was recorded, ranging from the very positive to the clearly less convinced.

For statements 7, 8, and 12, 100% agreement scores were recorded, showing that teachers were able to assess more easily, accurately, and at a deeper level how their students were coping with tasks and achieving desired outcomes when using the Flexcat. They agreed that the technology allowed them to unobtrusively witness the level and usefulness of contributions students make to small group discussions, including the normally shy. This is a unique feature of a CAD system that overcomes a key anxiety of teachers when managing small-group collaborative working, namely that it is not easy to know

that all groups are fully engaged with the set tasks and are making good progress. All the teachers also recognized that their students benefited from using the Flexcat pod to talk to them and to the whole class – a judgment fully in line with the view of their students as recorded in the student evaluation forms.

In statements 15 and 16, teachers were either in agreement (85.7% and 50.0% respectively) or neutral (14.3% and 50.0% respectively), with no teacher disagreeing with the statement about improved small-group learning positively influencing whole-class learning and the statement that the Flexcat had inspired innovation in teaching and learning.

All other statements drew a mixture of positive, neutral, and negative judgements. In 17 of the 20 statements, no strong disagreement was recorded, leaving only statements 5, 10, and 17 where one teacher recorded strong disagreement with a statement.

The highest levels of disagreement with statements were recorded in statements 6 and 9, where three teachers were somewhat in disagreement that their students were not less disturbed when the teacher used the Flexcat to talk to one group. This does not match the judgements of their students, 76.5% of whom were at least somewhat in agreement, nor did three teachers agree that they were better able to understand and respond to the needs of their students by providing better-informed feedback when using the Flexcat.

The percentage of teachers agreeing with a statement only fell below 50% for two statements (3 and 14) In reference to whether it was easier for them to deliver a differentiated curriculum to their collaborative learning groups when using the Flexcat, only one teacher was in disagreement while four were neutral; when it came to whether improved formative assessment as a result of using the Flexcat meant that they could plan with greater confidence and accuracy what the next steps were in learning for each of their students, two teachers were in disagreement, four were neutral, and one did not register a judgement.

75% of teachers thought the equipment was easy to use, and the same percentage judged that their students enjoyed their lessons more when the Flexcat was used. In only one school did the two teachers not want to continue using the Flexcat in their classrooms. One teacher was neutral about keeping the Flexcat, while the remaining five teachers in four schools wanted to continue using the equipment in their classrooms.

## Questions

Several commonly held positive and negative opinions could be identified from the teacher's responses to each question.

The most often reported advantages included improved speech intelligibility throughout the classroom whatever its size and shape; the teacher's ability to discretely monitor student discussions; their ability to provide intense support to one group while still being able to check what progress other groups were making, and being able to release groups to work outside the classroom without losing contact.

The most commonly reported disadvantage was the difficulty some teachers experienced when having to move the multi-unit system between classrooms. Having a system in each classroom would have alleviated this problem. For some teachers, students' distraction from learning caused by the introduction of the equipment took some time to overcome, and in a couple of classes teachers needed to manage student unhappiness at their discussions being randomly monitored. Most significantly, no inadequacy in the effectiveness of the Flexcat was identified by any of the eight teachers.

In judging what were the biggest advantages for their students, teachers identified the benefits students gained from the teacher's hearing and responding to comments they would otherwise never have heard. They judged that their students benefited from being able to hear clearly and speak clearly to the whole class; that they did not have to waste time asking for instructions to be repeated or need to repeat answers to questions, and their being able to seek help from the teacher as soon as they wanted it by using the pod call button. Also of note was the reporting by two of the teachers of the benefits that accrued from students using the teacher's earpiece and remote control to monitor their colleague's conversations. This produced a double benefit: on the one hand, the student doing the monitoring could appreciate how hard their colleagues



were working, and on the other, the students working in their groups appeared to stay even more on-task knowing that one of the class was able to listen to their conversations.

According to teachers, the main disadvantage for their students was the time it took some teachers to master the technology and use the full range of functions it was designed to deliver. My observations of lessons confirmed the accuracy of this judgement. Some teachers only used the equipment occasionally, so they didn't gain confidence in its management and couldn't remember everything the equipment could do or how to operate the remote control to activate the various modes of operation. Students being distracted from learning was mentioned by a couple of the teachers, as was their recognition that some of their students were unhappy at being randomly monitored.

The final question focused on ascertaining which groups of students particularly benefited from the use of the Flexcat. Overwhelmingly, teachers reported that shy students who often lacked self-confidence particularly benefited, because the teachers were able to hear their contributions to discussions and then intervene with support, encouragement, and an invitation to them to share their ideas with the whole class. One teacher working in a school with a higher-than-average number of deaf children and EAL students also judged that these groups gained most from the Flexcat system.

## **Student Evaluations Statements**

A total of 111 students in Years 7–11 from six schools completed evaluation forms on which they recorded their level of agreement with eight statements and responded to one question. Students were invited to record their level of agreement using a five-point scale, with 1 being least in agreement to 5 being most in agreement 5.

An analysis of the student responses shows a significant majority judging that they had benefited from the installation of the Flexcat system in their classrooms. Taking the more positive response levels 3-5 into account, their responses ranged between 72.0% at the lowest to 87.3% at the highest, with five of the eight statements given over 80% support. These five high-scoring statements included students wanting the Flexcat in all their lessons (81.0%); students enjoying their lessons more (86.4%); their having an enhanced ability to hear their teacher and other students; being heard when talking to the whole class (87.3% and 86.4% respectively); and that they and their group remained more on-task knowing their teacher could monitor their discussions at any time (81.0%).

Applying more demanding criteria of considering only levels 4-5 positive responses reveals that six of the eight statements secured over 50% agreement from students, with only statements 4 and 6 falling below this threshold (48.6% and 41.4% respectively). Where students were least in agreement (levels 1 and 2) scores ranged from 27.9% at the highest when responding to whether their confidence improved because they could be clearly heard when addressing the whole class, to 18.9% showing relatively little agreement with the idea of their benefiting from using the Flexcat system in all their lessons.

## **Question**

Only one question was asked of students, which dealt with the teacher being able to monitor their small group discussions. Of the 102 students who provided an answer, 59.8% wrote positively about how they benefited from the teacher being able to listen in and provide help when needed. Of the remainder, 20.6% felt accepting or expressed both positive and negative reactions. Only 19.6% were clearly unhappy about their teacher listening in or thought it was weird. Some students thought the equipment to be noisy.

Interestingly, on the evaluation forms completed by those students unhappy with the teacher being able to listen in to discussions, many recorded strong agreement with several of the statements—showing that they could still recognize the benefits while not particularly liking the monitoring feature of the technology. It is also apparent from the responses that the majority of students were confined to one Year 11 and one Year 8 class, leading to the possible judgement that one or two students with strong views in these classes influenced the thinking of a proportion of their colleagues. A number of responses all used the same or very similar phrase, such as “privacy invaded” or “weird.”

Overall, the results from the student feedback provide a strong endorsement of the benefits they see from having the system in their classrooms.

## Further Evidence

Much of what is reported above tallies with the conclusions drawn from analysis of the researcher/teacher-written lesson observation reports completed during the research period and the subsequent discussions held with teachers and those managing the research programs in their school.

Visits to lessons consistently revealed the extent to which teachers and students enjoyed the high-quality speech signal generated from the Flexcat's Redcat Access speaker that is fed from the teacher's microphone and the students' pod microphones. Teachers were able to quickly establish student attention and complete the transition between whole-class and small-group activity with minimum fuss and loss of lesson time. Both teachers and students regularly reported on the improved levels of on-task behavior among the students as a result of the teacher being able to monitor group conversations.

Some teachers were delighted with new insights into what students, particularly the shy and those lacking self-confidence, were capable of contributing and were able to encourage them to share their ideas with the whole class by speaking quietly into their pod rather than having to project their voice across the classroom. However, as shown in the teacher responses, at least one teacher felt almost overwhelmed with the amount of information she was confronted with when monitoring groups. Many students expressed how much they liked being able to address the whole class and being able to quickly get their teachers' help by their use of the pod call button.

In contrast, observing lessons also revealed, even with teachers experienced in the use of the Flexcat, their lack of consistent use of all the technology's modes of operation and the missed opportunities to support and enhance student learning that the technology provides.

Evidence from recorded conversations was more often positive than negative. Teachers recognized that for some students,

**“contacting the teacher (by using the pods) is far less public, so those not wishing to be seen as ‘boffins’ can do it without drawing attention to themselves and other members of their group can benefit from the response of the teacher without having to acknowledge that they needed or wanted help.”**

Some of the most positive feedback was given by teachers who were genuinely amazed and excited by the quality of contributions they overheard when using the monitoring function of the Flexcat while students engaged in small-group problem-solving activity. SEN teaching support staff in one school reported that when they,

**“withdrew from groups of SEN students when engaged in group work to ‘listen in’ to the quality and regularity of contributions from each student, they found students who took a lead role that they had not seen previously and others who contributed more and to a higher standard than had been previously witnessed. The staff recognized that their students worked very well at times when not being supervised by support staff.”**

A school with large open-plan teaching spaces reported,

**“a noticeable drop in classroom noise has been achieved in some lessons through the use of the features of the Flexcat system with both teachers and students not needing to raise their voice so much in order to be heard.”**

The video showing the Flexcat in use in Manchester Communication Academy classrooms is rich in positive comments from both teachers and students.

On a less positive note, one school senior manager reported,

**“I think the return to a more academic curriculum with the e-Bacc means that teaching, in general, is having to be more conservative in its approach due to content and end of course examinations. Project-based learning and the promotion of soft skills (both of which the technology works really well with) seem to have been sidelined. Depressing I know!”**

From talking to staff it is clear that school budgets have not kept pace with the growing demands placed on schools, making the purchase of what they see as expensive technology a genuine difficulty, however good that technology might be.

With schools only able to afford one or two Flexcats at best, the problems raised by several teachers of the difficulty they experience of moving the equipment to different classrooms is a real barrier to the widespread adoption of the Flexcat.

While it is clear that the majority of teachers on first contact with the Flexcat are enthusiastic about the range of possible new ways of supporting small-group collaborative work, this does not often translate into their wanting to use the equipment in their classrooms. Discussions with school senior managers revealed the difficulty they have had in persuading teachers to try the technology, and even in schools where some departments were convinced of the benefits the technology provided, they were not able to convince colleagues in other departments to undertake trials. It has proved difficult to find out exactly why this is the case, although some feedback indicates that some departments did not feel their approach to teaching and learning was compatible with using the Flexcat.

## Conclusion

Teachers who have used the system seem to fall into the following discrete camps:

- 1) those who are very enthusiastic users and believe they and their students are gaining much from its use in the classroom;
- 2) those who see some benefits for themselves and their students; and
- 3) those who are lukewarm, seeing some benefits but also, on balance, feeling that all the effort required to organize and set up the equipment in different classrooms is too much when they are having to think about so many other things.

When taking all the evidence into consideration, there are a number of key conclusions that can be drawn.

The technology allows teachers and students to potentially make the very best possible use of the available lesson time. The virtual eradication of the need for repetition and the ease with which students hear and comprehend what is being asked of them allow them to get on with the set tasks. Students' going off-task and disrupting learning is minimized by the teacher being able to discretely check what students are doing, groups are less disturbed when the teacher intervenes in other group's activities, and students no longer have to sit and wait for help when they are stuck.

The quality of teacher insight into the capabilities of individual students is significantly enhanced, making feedback to students more finely judged and useful. For those teachers working in large teaching spaces or for those who wish to place some students in neighboring areas, they can use these spaces with confidence knowing they can maintain contact.

Overwhelmingly, students enjoy their lessons more where the Flexcat is used.

Among the most striking negative issues raised by the trial of the Flexcat is the strongly felt dislike of what some students see as the teacher's unacceptable incursion into their group conversations. It could be argued that these students need to understand that if a teacher is to help them progress in their learning, then listening to what they are saying to each other when in groups is a necessary part of that activity. However, genuine feelings of grievance do need to be addressed rather than ignored if students are to effectively learn in the lessons where the Flexcat is used.

The problem of equipment management on a daily basis is also significant. Further modifications to the technology are needed if this problem is to be overcome.

It is interesting that the main problems identified with the technology were not to do with any of its key teaching and learning functions in support of small-group collaborative learning including improving:

- Speech intelligibility;
- Monitoring and assessing of student conversations;

- Delivery of discrete interventions;
- Student opportunities to share their thoughts with the whole class;
- Student on-task behavior;
- Use of lesson time;
- Use of available learning spaces; and
- Teachers' confidence in giving over more lesson time to student collaborative learning activity.

All of these areas received good to very good support, with only a minority of teachers disagreeing on some areas.

While the study was too short to research evidence-based improvements in student attainment, the list of benefits listed above would together suggest that over time, such improvements would be achieved.

With collaborative learning increasingly recognized throughout the world as one of the most effective learning strategies, the Flexcat can be seen as a very effective new technological tool to support this pedagogical approach. Reassuring teachers that their students are getting on with the task at hand removes a considerable barrier to this approach. No longer do they need to experience a feeling of not being in control when their students are working independently and at distance from them.

## **Acknowledgements**

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**Lesson Observation Form (blank)**

**Lesson Observation Schedule**

| <b>Observer</b>   | <b>Date</b>         | <b>Time in lesson</b> |
|-------------------|---------------------|-----------------------|
| <b>School:</b>    | <b>No of pupils</b> | <b>Year Group</b>     |
| <b>Teacher(s)</b> | <b>Subject</b>      |                       |

**Experience level:**

**Learning space:**

**Use of system**

**Whole Group Instruction (WGI)**

**Small Group Monitoring/Redirection (SGM / SGR)**

**Small Group Sharing (SGS)**

**Group/Individual seeking help (SSH)**

**Impact on teaching & learning (e.g. classroom management, learning behavior, level of understanding of task, pace, monitoring student input and rate of progress in SGM mode, teacher intervention in SGR mode, students sharing ideas in SGS mode, lesson coverage, use of learning spaces)**

**Teacher confidence in using Flexcat**

**Pupil confidence in using the Flexcat**

**Equipment ease of use & effectiveness**

**Redcat Access (clarity in WGI mode by teacher and students)**

**Pods (clarity of input and output)**

**Microphone & earpiece (comfort, volume control, quality of reception)**

**Remote control**

**Teacher feedback**

**Student feedback**