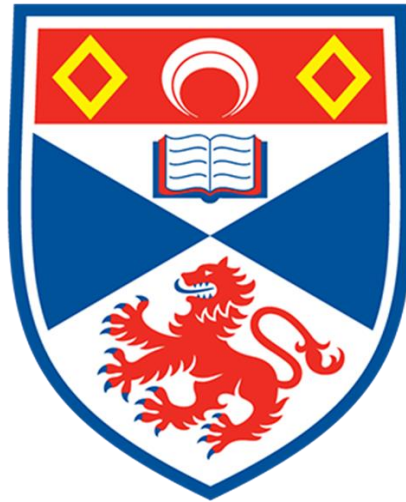


**Comparative evaluation of different forms of media about Cerebral Visual Impairment (CVI) in relation to effectiveness as a learning resource for schoolteachers, including establishing prevalence of awareness of CVI.**



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## Introduction

There are many different definitions of cerebral visual impairment, commonly referred to as CVI. Several describe how children are affected by CVI as a result of damage to the pathways and areas of the brain involved in visual perception, processing, and visually guided movement<sup>1</sup>. This research is focused on CVI and its adverse impact on learning. A study, looking at children in mainstream primary schools, identified common themes amongst those with CVI, which included perceptual difficulties, visuomotor deficits, impaired visual acuity, and motion detection<sup>2</sup>. All of which have a significant impact on learning.

For children with CVI, there can be reduced capacity for visual processing, and for many, cluttered, and busy environments, including many classrooms, can be challenging, potentially making the child with CVI confused and afraid<sup>3</sup>. Some affected children lack the ability to direct their gaze to stimuli and fixate their attention on a target<sup>4</sup>. Clutter is a hazard for children with CVI, due to the overload of sensory information that typifies clutter and busy environments<sup>3</sup>. One study on the behaviour of those with visual impairments, identified how some children with CVI made up for the inability to make sense of their environment through vision, by also employing touch<sup>5</sup>. Visual perception is complex but can be thought of as the idea of many processes coming together so an individual can locate and identify what is seen. The diminished perception experienced by those with CVI may be due to the lack of visual attention, as less visual information from the environment can be collected by the individual with CVI<sup>4</sup>.

The perceptual and processing difficulties experienced by those with CVI make learning a challenge, as one cannot learn visually from what one cannot see<sup>6,7</sup>.

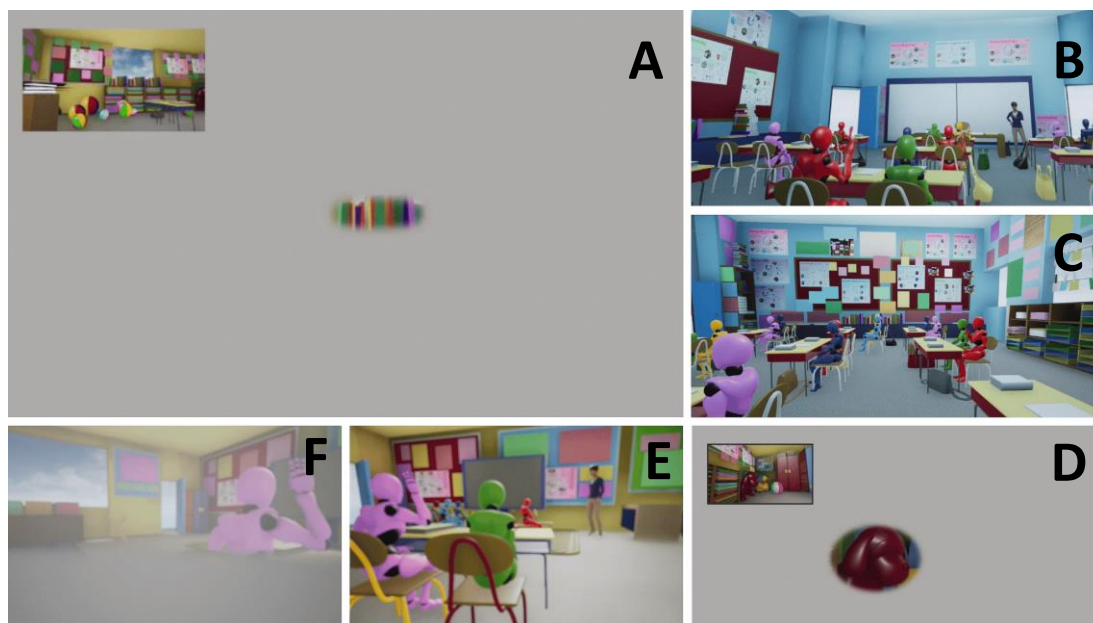


Image 1 – Virtual reality programme CVI-SIM with simulations of different cerebral visual impairments. Credit: CVI-SIM, University of St Andrews.

A) Simultanagnostic vision B) Typical Vision C) Typical vision D) Simultanagnostic Vision E) Reduced visual acuity F) Combined lower visual field impairment, reduced visual acuity and reduced contrast sensitivity.

CVI, other than when associated with epilepsy, is an untreatable disorder and is now the most common form of visual impairment amongst children<sup>7,8,9</sup>. In the UK 40-48% of children under the age of 15 with visual impairments, have been found to have CVI<sup>7</sup>. Furthermore, a study looking at CVI

across a mainstream population found that 3.4% of children had visual difficulties related to CVI<sup>2</sup>. Whilst more studies are needed, this would equate to just under half a million children in the United Kingdom affected by CVI (children make up around 20% of a population, the UK population is 67,330,000. 3.4% of 20% = 458,000 children in UK).

Despite this high prevalence, CVI is poorly understood and goes underdiagnosed. In Scotland, based on national statistics, 0.07% of children have a CVI diagnosis. This means that for every child with a CVI diagnosis, there are 50 who likely have a form of CVI and of those, forty are likely to be struggling at school<sup>2</sup>.

The lack of understanding and awareness of CVI may be attributed to the myriad forms CVI can take, making it difficult to understand what a child with CVI experiences<sup>9</sup>, because the visual impairment experienced by the child with CVI is different to those caused by ocular disorders<sup>7</sup>. This means that CVI may not be picked up by standard eye tests.

This study aims to evaluate two forms of media in terms of their effectiveness as a learning resource to aid understanding of CVI amongst teachers. One is a three-minute virtual reality simulation video, the other comprises a passage of text, taking around one and a half minutes to read. The text and audio for both media are exactly the same.

Teachers are in contact with students in their class on a daily basis and importantly, in a learning environment where CVI can have a significant impact. There are many things a teacher can do to make their classroom teaching more accessible. The media presented to teachers contained information on how a child with CVI experiences a classroom and what this may look like to someone with no understanding of CVI. The study used a Likert scale to see how likely or unlikely teachers were to adjust their classroom environment and the ways students are taught after learning what it is a child with CVI experiences. Additionally, the study aimed to understand how many teachers throughout the UK had heard of the terms Cerebral or Cortical Visual Impairment or CVI, as a way of establishing the prevalence of awareness of the condition amongst the teaching profession.

## **Methods**

Using a sample size calculator<sup>10</sup>, it was established that for 95% confidence intervals, the ideal sample size of the project would be 384 participants, based on assuming there are 637,000 full-time teachers in the UK<sup>11</sup>.

Two types of media, a virtual reality CVI simulation video and text were created (see Appendix), called the 'two medias'. The text and video audio were identical and were randomly distributed to teachers.

Two identical sets of Likert scale questions were created, each with seven questions, to measure the difference between the effectiveness and impact of the two medias. For comparison, one set would be answered before viewing the media, the other set after.

These seven questions asked teachers how likely they were to:

- Q1 Reduce the number of things on walls in classrooms.
- Q2 Wear plain clothes without patterns.
- Q3 Wear similar plain clothes each day.
- Q4 Sit or stand in roughly the same place when teaching.
- Q5 Use children's names when addressing them.
- Q6 Only have one thing at a time on boards and smart screens.
- Q7 Remove unnecessary items from the smart screen, for example icons and wallpapers.

The response options were:

- Definitely
- Likely
- Not sure
- Unlikely
- Definitely not
- Not Applicable

Not applicable might apply for example where a classroom does not have a smart screen.

After the media, the repeated set of questions asked, “Based on the media, how likely are you now to...”. An ‘Already Do’ response option was added to establish a level of commitment to the various practices, this was omitted in the first set.

Teachers were also asked what type of school they taught at, and whether before seeing this survey they had heard of CVI, Cerebral Visual Impairment or Cortical Visual Impairment. After the media, teachers were asked whether they thought they might have taught children with CVI.

Permission was sought to contact schools via local authorities and directly to headteachers, depending on the school type.

## **Results**

There were 111 complete responses.

<b>Answer</b>	<b>Score</b>
Definitely	4
Likely	3
Not sure	2
Unlikely	1
Definitely Not	0
Not Applicable	Remove
Already Do	No Change

Table 1: Likert Scale Scores

Not applicable = remove both answers to the same question, before and after the media, so total responses for each question varied.

Already do = Score as no change, e.g., if before answered likely (3) then after the media already do, the score for already do would be (3).

### Types of School Teacher

44 Secondary School Mainstream Teachers

43 Primary School Mainstream Teachers

14 Special School Teachers.

10 Other.

‘Other’ included teachers of the visually impaired, Peripatetics and Additional support needs teachers.

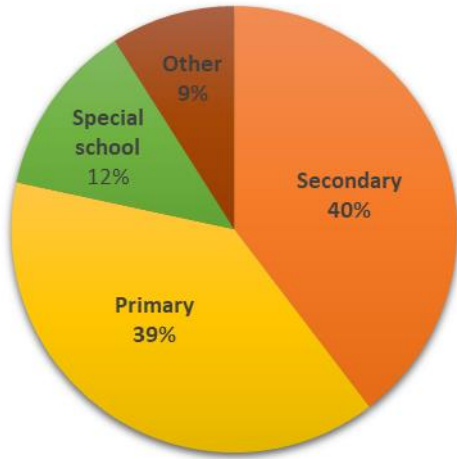


Image 2 – Pie chart representing the distribution of types of teachers that responded to the survey.

### Prevalence of Awareness of CVI

All teachers answered if they had heard of the terms:

1. CVI
2. Cerebral Visual Impairment
3. Cortical Visual Impairment

72% of teachers had not heard of any of the terms.

Primary	Secondary	Special	Other
98%	80%	21%	0%

Table 2 - Percentage of teachers who had **not** heard of the terms CVI or Cerebral / Cortical Visual Impairment, by school type.

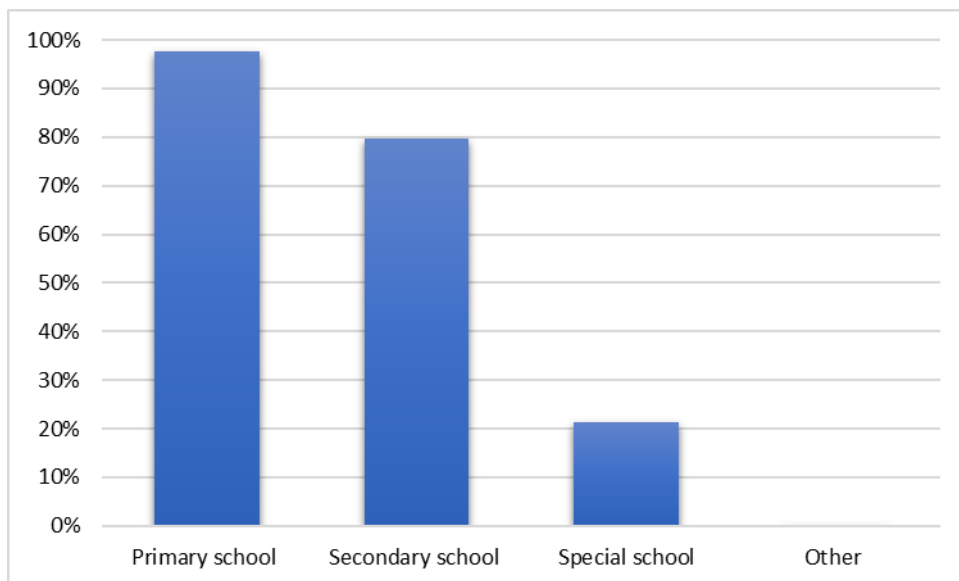


Image 3 - Percentage of teachers who had not heard of the terms CVI or Cortical / Cerebral Visual Impairment, by school type.

The average/mean score of the first set of seven Likert questions, answered before the media gave an average score per question of 2.6. Not Sure = 2 and Likely = 3, so between not sure and likely. After the media, the average score per question across all the questions increased to 3.2. Likely = 3 and Definitely = 4, so between likely and definitely.

Results by individual questions:

Question 1: Reduce the number of things on walls in classroom.

10 teachers answered not applicable so there were 101 responses. The average score before the media was 2.5, halfway between not sure and likely. The average score after the media was 3.2, between likely and definitely.

Question 2: Wear plain clothes without patterns.

2 teachers answered not applicable so there was a total of 109 responses. The average score before the media was 1.9, on the edge of unlikely and close to not sure. The average score after the media was 2.8 between not sure and likely.

Question 3: Wear similar plain clothes each day.

2 teachers answered not applicable so there was a total of 109 responses. The average score before the media was 1.9, on the edge of unlikely and closer to not sure. The average score after the media was 2.7 which is between not sure and likely.

Question 4: Sit or stand in roughly the same place when teaching.

5 teachers answered not applicable so there was a total of 106 responses. The average score before the media was 2.6, between not sure and likely. The average score after the media was 3.1, between a likely and definitely.

Question 5: Use children's names when addressing them.

1 teacher answered not applicable so there was a total of 110 responses. The average score before the media was 3.8, between a likely and definitely. The average score after the media was 3.9, so very close to a definitely.

Question 6: Only have one thing at a time on boards and smart screens.

2 teachers answered not applicable so there was a total of 109 responses. The average score before the media was 2.8, between not sure and likely. The average score after the media 3.4, between a likely and definitely.

Question 7: Remove unnecessary items from the smart screen, for example icons and wallpapers.

8 teachers answered not applicable so there was a total of 103 responses. The average score before the media was 2.6, between not sure and likely. The average score after the media was 3.5, between a likely and definitely.

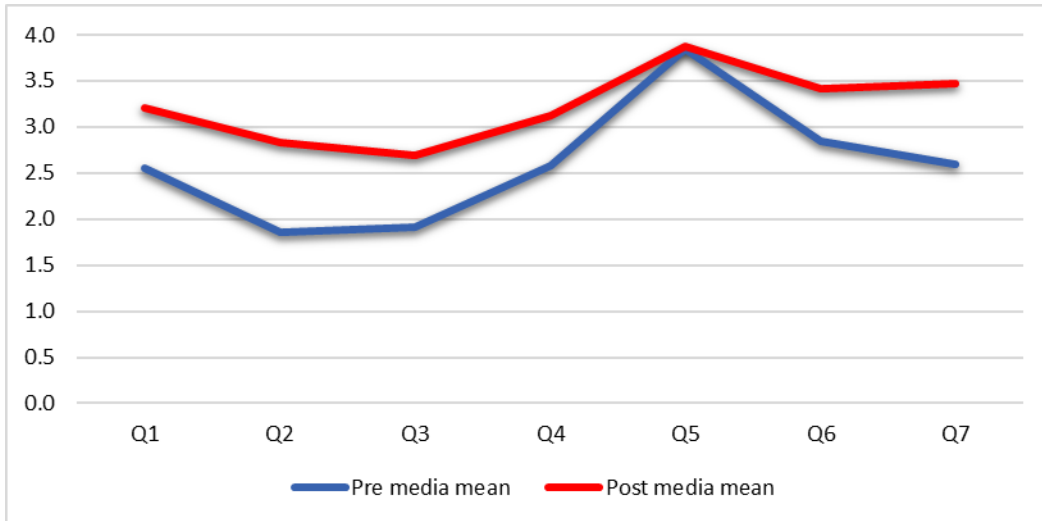


Image 4 – Graph showing the Pre media mean scores and the post media mean scores.

### Media Comparison – Text versus Video

66 of the 111 respondents got the text as media.

45 of the 111 respondents got the video as media.

The average score before reading the text was 2.5, halfway between not sure and likely.

The average after reading the text was 3.2, between a likely and definitely.

The average before watching the video was 2.8, between not sure and likely.

The average score after watching the video was 3.3, between a likely and definitely.

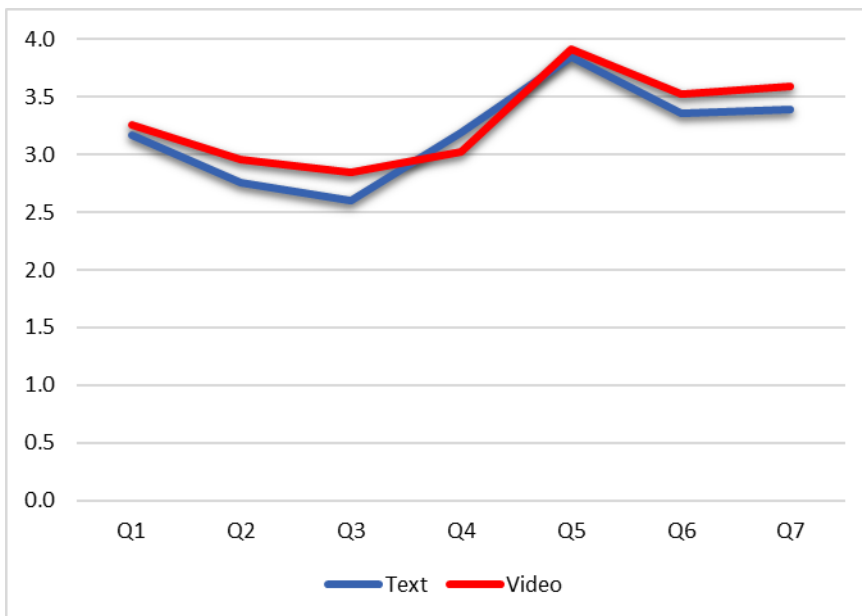


Image 5 – Comparison of post media scores of both media groups across all questions

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Pre media	2.5	1.7	1.7	2.6	3.8	2.6	2.3
Post media	3.2	2.8	2.6	3.2	3.8	3.4	3.4

Table 3 – Pre-media and post-media scores across all questions for those who read the text.

	Q1	Q2	Q3	Q4	Q5	Q6	Q7
Pre media	2.6	2.2	2.2	2.5	3.9	3.1	3.0
Post media	3.3	3.0	2.8	3.0	3.9	3.5	3.6

Table 4 – Pre media and post media scores across all questions for those who watched the video.

### Identifying possible CVI in children.

After reading the text or watching the video, the teachers were asked how many children they teach or have taught whom they think may have CVI.

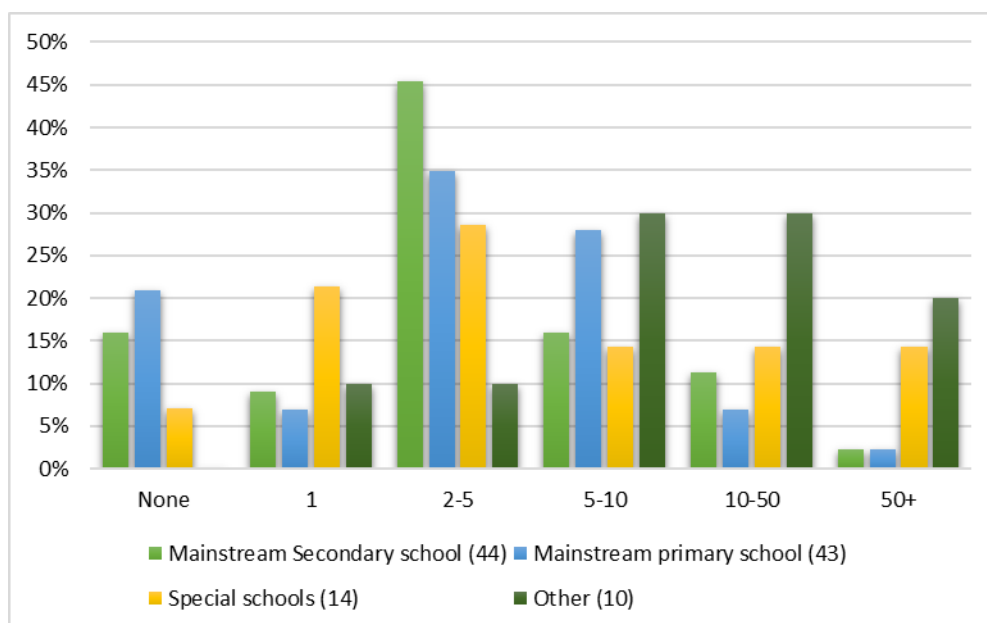


Image 6 – Bar chart representing by school type how many children teachers think they may have taught or teach that might have CVI.

- 17 answered none
- 11 answered 1
- 40 answered 2-5
- 24 answered 5-10
- 13 answered 10-50
- 6 answered 50+

<b>Number of children taught who might have CVI</b>	<b>None</b>	<b>1</b>	<b>2-5</b>	<b>5-10</b>	<b>10-50</b>	<b>50+</b>
Total Identified (111)	17	11	40	24	13	6
Teacher had not heard of CVI	15	8	32	17	8	3

Table 5 - Comparing how many teachers who had not previously heard of CVI were able to possibly identify it in children they had taught.

## **Discussion**

72% of teachers had not heard of the condition. Research shows CVI is likely to affect around a child in every typically sized mainstream classroom, and in special schools between a quarter to over a half of children may be affected<sup>2,12</sup>. Children with CVI require specialist support across many areas in school, including around literacy and maths, to help with attention and friendships. The lack of awareness of CVI amongst mainstream schoolteachers is an area that needs urgent attention.

Both media types presented to teachers were three minutes or under. This meant teachers received a very quick introduction into a condition that is very poorly understood by many including professionals and parents<sup>9</sup>. Across all the questions, teachers answered that they would make changes, for example where they answered ‘not sure’ to a question before viewing the media, they answered ‘likely’ after. These changes will have a positive impact on children’s lives by providing them with vision-based support they need to learn at school<sup>2</sup>.

The video was under three minutes long and the text involved less than two minutes of reading time. These could be considered ‘bitesize’ resources. Whilst small, the impact was clear and considerable. When it comes to resources for teachers, allowing for how busy they are, bitesize resources may prove to be useful whilst economical both in terms of cost and time.

Question one, six and seven addressed reducing clutter in learning environments. Clutter on walls, on boards and on smart screens create a barrier to learning for children with CVI<sup>3</sup>.

Questions two and three asked teachers about the clothes they wore. Initially most said they were between an unlikely and not sure about changing their patterned clothes, then after the media the average answer was between not sure and likely. This was the same with wearing similar clothes each day. It is incredible to see that teachers were willing to consider making such personal changes based on only a few minutes of teaching.

Question four referred to teachers sitting or standing in the same place when they teach. Following a teacher around a classroom adds difficulty to learning as some children with CVI lack the ability to locate stimuli<sup>4</sup>.

Nearly all teachers said definitely to Question five, related to using a child’s name when speaking to them, meaning the media could only have minimal impact. This is very helpful for a child with CVI who may not otherwise be able to tell who the teacher is addressing.

Question 7 related to clutter on smart screens. All 8 ‘other’ teachers responded, ‘not applicable’, leaving 103 out of the 111 teachers answering question seven. This means every mainstream and special schoolteacher used a smart screen in their classrooms. Guidelines from CVI experts about smart screen use would be helpful.

Whilst assessments and diagnosis are required to confirm CVI, both the text and video were effective in helping teachers identify children who might possibly have CVI.

Both the text and video performed well and almost identically. One point equals a change of one step up the Likert scale, for example from not sure (score 2) to likely (score 3). The text led to an increase of 0.7. The video led to an increase of 0.5. Teachers are all educated at least to degree level. The video, having performed effectively in relation to being an agent for change, may be a better resource for more educationally diverse groups, for example parents. In the UK the average adult reading age is nine<sup>13</sup>.

### **Limitations**

A sample size of 384 participants was needed for a confidence level of 95%. The research window was only six weeks during which period 111 questionnaires were completed. The two medias were very short to keep the whole questionnaire under five minutes. A longer resource may have provided different results. The results in relation to the impact of the medias were highly consistent. Whilst further research is needed, these findings show a very positive trend, that across all area's teachers were willing to make changes.

The data collected by the survey was anonymous. The advantage of this was that respondents could be honest in their opinions. However, it is possible that some participants were not teachers or not truthful.

### **Conclusions**

Whilst more research is needed, the findings from this study indicate a lack of awareness of CVI amongst teachers in the UK, particularly in mainstream schools. Our results suggest that these children are very likely to be unsupported at school.

Results also suggest that video simulation proved as effective as orthodox text as a learning resource for this group.

The teachers who took time out of their busy days to participate in the survey have shown that after reviewing a resource for less than three minutes (about a condition most had never heard of) they were willing to make changes and adjustments to teaching approaches, in the classrooms and how they dress. These changes are likely to lead to improved support at school for those with CVI, improving participation educationally and socially.

### **Ethics**

Ethics for this research was approved by the School of Medicine, University of St Andrews on 2<sup>nd</sup> May 2023, Approval code: MD16936.

### **Acknowledgments**

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## **Appendix**

Below is a link to the virtual reality simulation video, and the text presented to teachers. Media Credit: CVI-SIM, University of St Andrews <https://medicine.st-andrews.ac.uk/vision-in-childhood/>

Link to the video: <https://vimeo.com/823455099>

Text:

Being a teacher of a classroom of children with different needs is hard. In addition to knowing specialist areas, most teachers now need to also understand the support needs of children who face many challenges due to autism, ADHD, difficulties learning, different mental health issues and more. There is also common but widely unknown medical condition that has been associated with all of these difficulties.

Research has shown that there are some children at school who may be struggling due to this condition, but with adjustments to the classroom environment and the way they are taught, it's effects can be reduced. It's called cerebral visual impairment, often shortened to CVI.

CVI is missed because in most cases the child's vision is sharp, and so it is not picked up in standard sight tests. But they still do have a visual impairment. CVI can cause perceptual visual difficulties.

What does that mean? It is probably easier to explain what it may look like, compared to typical vision.

Imagine your classroom from the perspective of the child. What can they see? You, a whiteboard or smart board, pictures on the wall, books, other children and more. All at the same time. A complete view of the immediate world. That's what a child with typical vision sees.

With CVI the child can often only see one thing well at a time, so they can't see you and the board together easily, only one or the other. If there are lots of things on the board, they might only be able to see one of those things at a time. Having to move their sight repeatedly between you, the board and a book on their desk is difficult and tiring and will slow their learning down. They might lose what they're trying to look at, like you, especially if you move about whilst teaching. Looking and listening at the same time can also be very difficult. If there is extra noise, either from within the room or outside, that can mean they might not see so well. But these added difficulties are all normal for the child with CVI, so they're not likely to complain about it even though they are struggling.

To you, what it may look like is a child who is not paying attention. A child who is easily distracted. A child who can't keep up with the class. The child with CVI will however be working extremely hard to stay focused and keep up. There are many things you can do to help. Reducing the number of things 'to see' on walls will help enormously. A growing body of research has shown that all children study more effectively in classrooms with less on the wall. With CVI, this can help the child see more easily and therefore see more.

If you wear plain clothes, ideally sticking to the same bold colours, you will help the child with CVI not only see more but find it easier to see you and recognise you. Many children with CVI find recognising faces difficult.

Stand or sit in the same place when teaching, rather than move about. If addressing children, always use their names rather than expecting them to know who you mean by looking at them or pointing to them.

When using boards or screens, limit content to one thing at a time. If using a smart screen, ensure everything that is not necessary, for example icons and wallpaper, is not visible.

There may be a child with CVI hidden in your class. These small changes can be transformative to some, opening up a new world of learning opportunities.