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Study of an inclusive intervention programme in pictorial perception with blind and sighted students

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ABSTRACT

This study evaluates the effectiveness of an intervention programme administered to blind and sighted school students. The students were given information concerning style, author and technique of three paintings from three different artistic periods, as well as guidelines to assess the overall aesthetics of each image. This programme was administered to 28 participants: 7 totally blind (the entire population of blind students in Castilla-La Mancha) and 21 sighted peers. Several methods of accessibility, such as verbal description of the content, sounds from the scenes and music from the artistic period, were implemented. Blind students were provided with tactile diagrams instead of reproductions of the paintings. A performance test was designed to assess qualitative and quantitative aspects and the collected data were analysed. Learning outcomes of blind and sighted students were compared after intervention and one month later. We found no significant differences between blind and sighted peers in content acquisition or aesthetic appreciation of the images. These results support the suitability of common accessible instructional strategies for the inclusion of blind students.

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Blindness; art education; painting; access for the disabled; pupil integration

Introduction

This work responds to visually impaired pupils' need to have access to knowledge of art and the opportunity to experience aesthetic pleasure. Traditionally, blind people are thought to be incapable of performing art tasks. As pointed out by Révész (1950, 161), 'To judge from the limited perceptive capacity and apprehension of form by the blind, one might deduce that they are completely unable to apprehend forms from the plastic art, such as to appreciate the aesthetic value'. On the contrary, other works reviewed by Derby (2011), who conducted a historical review of the relationship between art and disability, defend an interdisciplinary dialogue in the implementation of art education, which tends to focus on literature, theatre and visual arts, aiming to develop artistic expression.

The aim of this work is to explore the effectiveness of an intervention programme in the study of paintings, using measures of accessibility for students with visual disabilities, such as tactile (fuser technology) and auditory resources (sounds from the scenes depicted in the

picture). For this purpose, the learning outcomes are measured through a performance test on the knowledge acquired about subject matter, style, author and technique (endorsed and corrected by experts). The learning outcomes of students with and without disabilities are compared through qualitative and quantitative analysis.

The present study is based on trends that support research of the inclusion in the school curriculum of visual arts education, specifically addressing students with disabilities (Eisenhauer 2008a, 2008b). One of the advantages of shared art education is the construction of a more 'realistic' and less stereotyped perspective of disability. This is one of our main purposes, through concrete activities based on previous experiences, such as those of Lewiecki-Wilson and Brueggemann (2008). These authors suggest some shared art activities for students with and without disabilities, using techniques such as documentary films, graphic novels, comics, videos, drawings, paintings and the performing arts. We have chosen painting due to the lack of empirical studies in the academic context on this field.

Drawing on the review of the literature on teaching art to blind people and experiences in museums, we analysed multimodal neurological bases of perception, accessibility measures and educational experiences. We implemented an inclusive intervention programme with comprehension skills and measures of access such as two-dimensional sheets (fuser plate) and sound aids.

Teaching pictorial art to blind people and experiences in museums

Several pioneer authors studied the art dimension in blind people. Lowenfeld (1939) wrote about a method and developed a theory of aesthetics in the artistic products of blind people. Later, other researchers extended the approach to general disability. Lundins-Katz and Katz (1967) described practical experiences to stimulate creativity to paint in disabled and non-disabled persons. These first efforts led to subsequent teaching in inclusive contexts.

With regard to teaching blind students about paintings, our starting point was the experiences conducted in Italian museums, such as the visit to the Sistine Chapel described by Miglietta (1997). Cioppi (2008) proposed guiding techniques to accompany blind people (taking their arm, going up staircases, showing models, etc.), as well as strategies to 'see with the hands and touch with the eyes', in order to appreciate works of art, using materials such as plasticine, tactile diagrams, thermoforms and scale reproductions.

In Spain, studies have been conducted at the University of Granada (Muñoz 2007) and in Madrid at the Reina Sofía National Art Centre Museum, using Picasso's *Guernica* (González 2008). They were based on the advice of previous studies about blind people's access to museums (García 1993; Martín and Luengo 2003). These experiences used narrative descriptions and, in some cases, low-relief tactile models (Cela 2002; Consuegra 2002).

The work of Hayhoe (2013a), based on drawings on participant observation and interviews, concludes that, for blind people, proximity to works of art in natural settings such as museums is more rewarding than reading about them or visiting them on the Internet. Other authors find that blind people are excluded from the perception of works of art, mainly due to the lack of access measures and resources. Candlin (2003), (2004) points out that the absence of access measures, such as tactile resources, is more passive (due to the lack of knowledge about their needs to perceive and learn about the paintings) than active (discrimination).

Axel and Levent (2003) suggest a series of guidelines to help museum educators and art teachers create a verbal description of a painting. The description should include standard information: artist, title, location in the museum, subject, form and colour, orientation and direction, as well as technique and style, and information about the social and historical context. The authors recommend the use of vocabulary suited to blind people (avoiding figurative language). Vivid details should be provided, as well as information about the location in the museum. Reference should be made to other senses as analogues for vision, and intangible concepts should be explained with analogies. The authors also recommend the creative use of sound. In addition to the use of tactile illustrations of artworks, people should be allowed to touch the works of art. Moreover, these authors provide guidelines for the creation of tactile diagrams and the accompanying oral scripts. In this way, people with visual disability are provided with the perceptive information required for complete intellectual access to the history and culture of our world.

In view of these experiences, visual arts can be taught to blind people. However, what are the neurological bases of multimodal perception? Is it different in blind and sighted people? Are there adequate methods to teach visual arts to blind people? Which is better: access measures or inclusive programmes?

Multisensorial activity and perception in blind and sighted people

Blind people are assumed to learn about space and objects in a similar way to sighted people, but mostly based on haptic sense instead of on visual perception. Reviewing the background, Révész (1950) in the pioneer and excellent work on this topic, established the fundamental bases of the theory of Haptics (tactile and kinematic sense). Haptics constitute the beginning of a theory of form based on visual experiences. This author dealt with the two kinds of haptics: visual haptics for sighted people, and pure haptics for the blind. They both obey the same laws. Révész (1950) established 10 principles of haptic forms but stated that the haptic perception of objects lacks the conditions for aesthetic appreciation. Some applications were implemented to haptic pictures by authors like Kennedy (1982, 1993).

The incipient hypothesis of haptics has accumulated some empirical support (Kennedy 1993). For instance, cognitive neuroscience researchers are interested in how the information from different sensory inputs (visual, tactile, proprioceptive) are integrated in the brain. In this sense, using the crossmodal confluency task (congruent and incongruent vibrotactile targets and visual distractors) with normal subjects and brain-damaged patients, some researchers have explored the multisensory representation of space to locate tactile stimuli, feel position of the limbs and represent peripersonal space (Spence et al. 2008).

From the field of neurology, the neural bases of visual–tactile interactions in relation to spatial attention have been investigated. Several authors review the evidence from various researchers (Kennett, Eimer, Spence and Driver, cited by Magoso et al. 2010) who have investigated the neural correlates of crossmodal attentional interactions using event-related potentials and hemodynamic measures. Some results support the idea of a supramodal system that controls attentional orienting in different modalities. This is consistent with recent neurophysiological findings of multimodal neurons in the parietal and premotor cortex (Duhamel, Colby, and Goldberg 1998; Rizzolatti et al. 1981; cited by Magosso et al. 2010).

Based on the findings of multisensorial brain activity, some authors have researched on perception of tangible pictures in sighted and blind people. Some authors observed that blind people 'vary greatly in their educational experience and in their perceptual skills' (Heller, McCarthy, and Clark 2005, 161). They subsequently selected participants including blind-folded sighted subjects, congenitally blind subjects (CB), late-blind subjects and subjects with very poor vision (VLV). Through several tasks, like Picture Naming Studies, they found that naming failures were related to semantic memory, more than to perception, and performance was increased when a superordinate category was provided. This showed the importance of categorical information. In other tasks, like Picture Recognition without Naming, the authors examined the impact of semantic memory, in which participants had to select a designated target in relief. The recognition task improved performance of the interpretation of haptic pictures. The authors concluded that two-dimensional picture perception could be excellent for people with visual disability. In addition, the authors explained the superior performance of the VLV subjects in terms of visual experience, visual imagery and perceptual skills (Heller, McCarthy, and Clark 2005) but their sense of touch was much slower than their sight. However, Norman et al. (2004) and Kilgour and Lederman (2002) reported a poorer performance in haptic tasks of matching of natural, three-dimensional objects and matching faces to a person's face, respectively.

Von Senden (1960) initiated the interesting field of space and sight. Regarding perspective, congenitally blind people can understand perspective in raised-line drawings, despite a lack of familiarity with this material (Heller et al., 2005). Hence, visual experience is not necessary to understand perspective (Heller and Kennedy 1990). However, instruction about the principles governing perspective was helpful to CB individuals, as well as to sighted persons. Likewise, gaze direction is an important contributor to haptic performance, as well as the location of one's hands in space. Tangible pictures can convey considerable useful information to blind people and even more if minimal experience or explicit instruction is provided.

With regard to the use of sound, Sánchez (2010), on the basis of 10 years of training experience with visually impaired users, provided guidelines on how to use sound-based virtual environments to enhance cognitive development and learning. This author argues that spatial sound can help to improve haptic perception, memory, tempo-spatial cognitive skills, mobility, orientation, mathematics and science learning. Furthermore, the fidelity of the sounds favours the transfer of virtual learning to real-life situations. Sánchez proposed a sound-based virtual environment to be validated in four phases: analysis of applicable technology, design of cognitive activities based on standardised tasks, user-based implementation and validation based on expert opinions. Learning is assessed using research designs starting with a pre-test, followed by solving cognitive tasks (modelling and representation) and finally by a post-test. Sánchez (2010) cited the study by Ramloll and other authors, which concludes that the use of non-speech sound reduces cognitive workload and permits successful task completion.

Accessibility measures by tactile and sound perception

Considering perception, and specifically tactile perception in blind people, Mouchet (1938) was one of the first authors who dispelled doubts about the supposed greater sensitivity of blind people's fingers, finding no difference between the sensitivity of the fingers of blind

people who did not read Braille and sighted people's fingers. Studying the perception of weight based on tactile appreciation, Plata (1957) found that weight perception increased around age 14, but was influenced by the amount of stimulation received previously. Findings showed that using tactile exploration, blind participants achieved similar results as sighted people. Palacín (cited in Plata 1957) also found that training enhances blind individuals' perceptual sensitivity and confirmed the importance of hearing as a substitute for sight, in areas such as reading, writing, mathematics and geography.

As stated by Rosa and Ochaíta (1988), blind people tend to present delay in certain operations, influencing negatively on spatial and temporal relations. However, this delay does not affect verbal tasks, including formal ones. Thus, development of mental images through perceptual stimulation in early childhood is highly recommended. Ochaíta, Huertas, and Espinosa (1991), in another study on spatial representation among blind children, concluded that the earlier this training is implemented, the better is spatial representation in later years.

Clearly, there may be considerable difference between how sighted people see a visual image, and how blind people perceive the tactile version derived from a physical representation of this same image. It should be noted that tactile perception entails other factors such as the appraisal and perception of texture and the development of tactile discrimination. The impact of training on tactile development also means that blind people's performance of tactile perception tasks can often seem surprising (Rosa and Ochaíta 1993).

Teaching pictorial works to students with visual disabilities in inclusive school

Based on the demand for blind children's access to visual arts, specifically painting, Douglas et al. (2011) reviewed the literature on the concept of school access and described implications for teaching at various levels: classroom practice, special education, curriculum adaptation, professional training and interprofessional coordination. They emphasised the concept of access, and made a distinction between two key access strategies: 'teaching access skills' vs. 'providing accessible material'. Although providing children with accessible material (e.g. large print) is the preferred medium for blind children, teaching access skills is a more inclusive practice. Comparing these two approaches, these authors concluded that there is greater long-term benefit to teaching children 'access skills' (including the use of technology).

Regarding inclusion of visually impaired children, Pelechano and García (1999) confirmed the efficacy of programmes designed to integrate blind children in school settings. Lohmeier (2005) suggested that the instruction of blind students should not only focus on the core curriculum, but also on academic and specialised skills such as social development, recreation and leisure, independent living skills, orientation and mobility, technology, development and visual efficiency. The author labelled this the 'expanded' curriculum and suggested that it could be delivered during or after the school schedule. This argument supports the need for a specific art education programme for visually impaired students focused on pictorial works. Likewise, this author considered the inclusive education to be the preferable option. Publications on instructional strategies to work with students with visual impairments have been published, such as that by Koenig and Holbrook (2000). We have also found curricular projects such as the multiprofessional PAVE (Providing Access to the Visual Environment) project, aimed at individuals between ages 3 and 21 (Corn et al. 2003), or the wider-ranging

IDEA (Individuals with Disabilities Education Act) programme, which is applicable to all types of students with a disability (LaVenture 2003).

The advances in new technologies are gradually being implemented, like in the study of Argyropoulos, Sideridis, and Katsoulis (2008). A notable example is the multimedia format 'Daisy' (Ribere and Moese 2008), which integrates text, sound, images and video in a synchronised sequence. Navigation is simultaneously possible through text and audio. The format also includes activation of videos. The basic component is the xml DTBook, a structured format that permits the creation of alternative format editions. It is intended as an alternative format for eBook publishing but it has been criticised for its high cost and also for issues concerning digital reproduction rights.

Zebehazy and Wilton (2014a) studied the responses to an electronic survey of teachers of students with visual impairments about tactile and print graphic use. Less than 50% of the teachers surveyed considered that graphic aids adapted effectively to large-scale assessment. Teachers were not sufficiently trained in the use of graphics. More teaching time is needed to read graphics, and continuous supervision of the quality and effectiveness of the graphics is also required. This study highlights the importance of training in tactile perception. Hayhoe (2013a) also suggested that building a relationship with artworks is possible by perceiving the aesthetic qualities through subject matter and different impressions on the senses.

Lusk, Lawson, and McCarthy (2013) concluded that a broad range of medical and educational professionals is needed to fully access visually impaired students and to provide 'conventional literacy' programming.

According to research conducted with school students, Hayhoe (2013b) worked with visually impaired and sighted students on activities such as museum visits and the creation of pieces of art. Using participant observation methodology, the study concluded that blind students could teach sighted children about the elements of perception. They also had as much potential to develop art works as their sighted peers.

Regarding academic intervention in school, Kamei-Hannan, Holbrook, and Ricci (2012) proposed the Response to Intervention Model to work with blind or visually impaired children on the narration of paintings, using a problem-solving approach and ongoing assessments. They suggested evidence-based academic activities and interventions, which should be progressively implemented and monitored in order to adapt to the learning process.

As a result of the literature review, we can confirm that the existence of prior experiences of the teaching about paintings to blind students. Activities have been carried out in museums, employing a large range of educational strategies such as narrative-descriptive, haptic and auditory techniques and bodily expression. However, there is little empirical research providing evidence of the effectiveness of these interventions in school settings.

Teaching literacy to visually impaired or blind students involves the use of a variety of sensory (visual, tactile, motor and auditory) and cognitive factors that, along with interventions conducted during the school years, predict general academic performance. This also extends to the study of pictorial works as an area of academic development and learning.

Table 1. Diagnosis of the blind participants.

Participant	Visual impairment diagnosis
1	High progressive degenerative Myopia
2	Non-specific nystagmus
3	Inherited retinal dystrophy
4	Retrolental fibroplasia
5	Congenital cataract. Crystalline anomaly
6	Retrolental fibroplasia
7	Microphthalmia

Method

Participants

First, we conducted a search for totally blind students integrated in mainstream schools, locating a total of seven in the region of Castilla-La Mancha (Spain). All of them were born blind, they had no visual memory and were Braille readers. The diagnosis for blind participants is shown in Table 1.

The sample thus comprised the entire population with these characteristics. The schools were located, and informed consent was obtained from the school councils and the students' parents. We then requested the collaboration of sighted students from the same classes as the blind participants. Three of them were randomly selected to compare the effectiveness of the intervention in the blind students and their sighted counterparts. The class teachers were asked to randomly select three students, including at least one male and one female of a similar academic level to the blind student. In this way, the sample would comprise sighted students of similar academic characteristics and gender identity to the blind sample, but in a greater number in order to have a larger representation of sighted students. Consequently, the sample comprised 28 participants, of whom 7 were completely blind. The mean age of participants was 12.5 years, ranging from 9 to 16 years ($SD = 2.44$). Regarding educational level, 46.5% were studying primary education and 54.5% secondary education. Males comprised 50%. The blind students came from diverse academic courses: four students attended primary school (4th, 5th and 6th course; two students in each course); and three students attended secondary school (1st and 2nd course, one and two students, respectively). The visually impaired students from the same towns were in different classes but in the same school.

Materials and instruments

Three internationally recognised paintings of different artistic styles were presented. An intervention programme was administered using various methods that combined different sensory inputs in order to verify their effectiveness in the acquisition of cultural knowledge and skills for appreciating visual arts. The selected pictures had to meet a series of requirements: simplicity, schematic strokes, lack of perspective, flat figures or figures of an easily explainable volume, with no colour or lighting problems in order to facilitate the blind students' understanding. Subject matter had to be varied, as recommended in art education (Axel and Levent 2003). The following paintings were chosen to be explained both to blind and sighted students: 'The Knight with his Hand on his Breast' by El Greco, 'Picador' by Fernando Botero and 'Woman in front of the Sun' by Joan Miró.

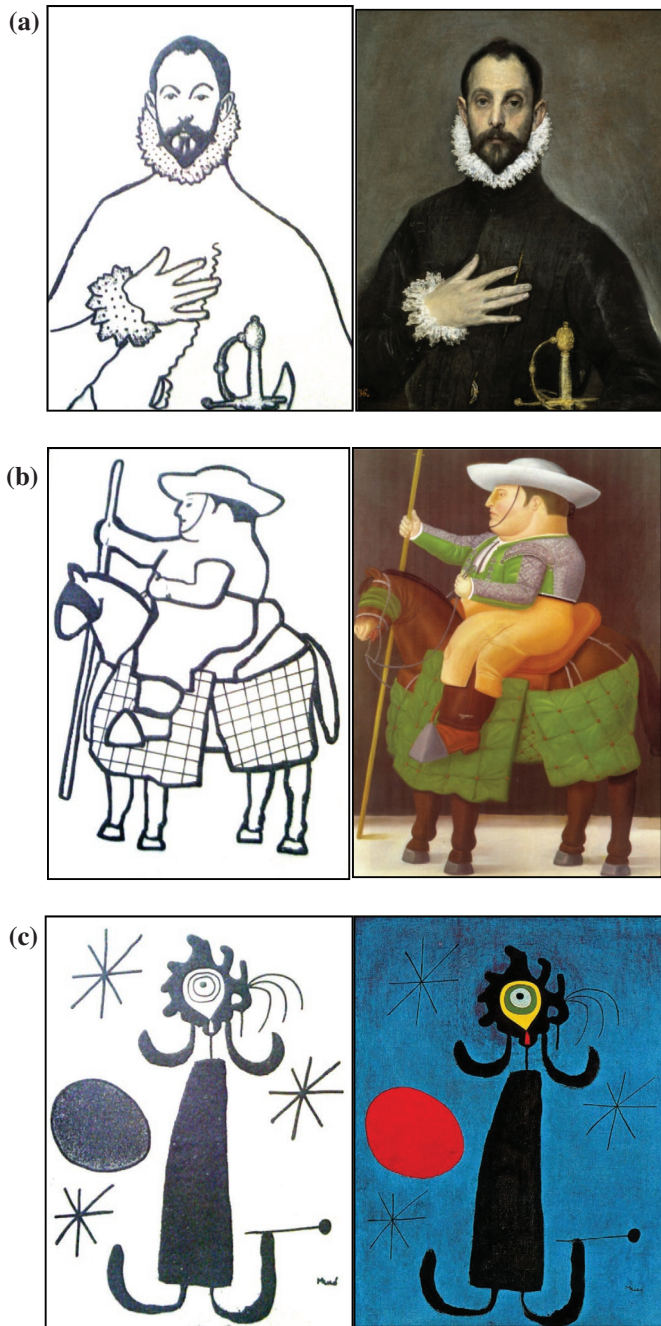


Figure 1. Reproductions of the selected pictures and their corresponding tactile diagrams in fuser plates: (a) 'The Knight with his Hand on his Breast' by El Greco (Retrieved from: <http://uploads8.wikiart.org/images/el-greco/the-knight-with-his-hand-on-his-breast.jpg>), (b) 'Picador' by Fernando Botero (Retrieved from: <http://uploads2.wikiart.org/images/fernando-botero/picador.jpg>); and (c) 'Woman in front of the Sun' by Joan Miró (Retrieved from: <http://uploads5.wikiart.org/images/joan-miro/woman-in-front-of-the-sun.jpg>).

Note: Reproduced with permission.

The materials used were three reproductions of the selected pictures or their corresponding tactile diagrams in fuser plates (for the blind students) as presented in Figure 1.

The intervention was administered similarly to blind and sighted peers, in individualised sessions. The only difference was in sensory appraisal, which was visual for the sighted students (colour A4 reproductions of the paintings) or tactile (fuser plates) for the blind ones (see Figure 1). Along with these materials, several explanations, and the same for both blind and sighted, were provided, consisting of:

- Verbal description: it consisted of explanations of the content of the painting (title, characters and objects depicted), subject and style (idea and purpose, technique, historical period, artistic style) and author (painter's name and life story). These were taken from the standardised museum explanations and adapted to the language of the participants' corresponding educational level.
- Auditory aids: audio files reflecting the music of the period and the elements represented in the pictures to provide further information on the subject matter were played during the verbal explanation of the painting to blind and sighted pupils.

AUDIO 1: <http://www.goeear.com/listen/e00a382/sonidos-escena-caballero-mano-pecho-carmen-carpio> (see <https://youtu.be/BYIIDSu04iM>)

AUDIO 2: <http://www.goeear.com/listen/5da765a/sonidos-escena-picador-carmen-carpio> (see <https://youtu.be/SUpZjyhej6k>)

AUDIO 3: <http://www.goeear.com/listen/e804698/sonidos-escena-mujer-sol-carmen-carpio> (see https://youtu.be/OJU4_X-snY)

To assess the blind and sighted students' knowledge of the paintings, a performance test with 10 questions, 1 for each painting, was designed: 7 multiple-choice (Section Introduction) and 3 open-ended questions (Section Method). All questions in Section Introduction referred to major aspects of the perception of a painted artwork: name of painter, historical and artistic period, topic depicted, characters and objects, artistic style and technique. The first question measured the students' knowledge of the painter and the work of art and was designed to control for prior knowledge, a possible variable biasing learning outcomes. The following six questions (2–7) were all content-based, and participants had to select one of three possible answers. Responses were coded according to the criteria of three judges: primary and secondary school visual arts teachers. Scores (1/0) were given for correct/incorrect answers.

Section Method was designed to assess aesthetic appreciation by activating thought, and students were free to make comments and express opinions about the paintings' suggestions (Questions 8–10). Responses were analysed qualitatively and scored according to their level of complexity. The judges established criteria, and scores from 0 to 5 were assigned to each question. Interjudge agreement was high, reaching a mean of 86.1%. Agreement for 'The Knight with his Hand on his Breast' was 89.5%, for 'Picador', 86.5% and 86.5% for 'Woman in Front of the Sun'.

All the questions were simply and clearly worded and adapted to the different students' educational level. They referred to the objectives of the area of visual arts education in Primary and Secondary Education (Royal Decree 69/2007 of 29 May 2007).

Procedure

Presentation of the paintings followed the same coordinated intervention procedure, both for blind and sighted students, in individualised sessions. The presentation included a verbal description of the essential content described above. Each painting was explained following specific instructions including standardised expository methods appropriate for blind students. The presentations were given in specific classrooms by the ONCE support teachers, who were previously trained in the procedure.

The sighted participants were shown colour reproductions of the paintings, while blind participants were provided with a tactile diagram of the picture. In both cases, participants listened to recordings of sounds alluding to the subject matter and music from the corresponding artistic period during the presentation.

Following the presentations, the performance tests were administered to monitor learning and art appreciation (TEST_1). One month later, the performance tests were administered again to verify the amount and type of knowledge retained (TEST_2). The responses were scored using the same criteria as in the original test.

Results

We first present the results of the qualitative analysis and then those of the quantitative analysis. The qualitative content analysis of the open-ended responses (Section Method, comprising questions 8–10) was conducted using inductive methodology. Atlas.ti 6.0 software was used. Responses were classified according to the content of the paintings and references to aesthetic appreciation such as taste, opinions and experiences. The terms for these categories were qualified and the content analysis revealed some categories shown in Table 2.

An example of an answer for Question 8 (see Table 2), referring to the El Greco painting made by (a) blind participant: 'It's a thin man, a fighter because he's got a sword' and (b) sighted participant: 'He's swearing an oath'. These answers were classified as association of ideas (see Table 2). Other examples for Question 9 were classified as characters or figures (see Table 2) for the El Greco: (a) blind participant: 'I like the cuffs and what they sound like'; (b) sighted participant: 'I like the sword and the clothes'. Finally, these examples for Question 10 were classified as aesthetic analysis and degree of liking (see Table 2) for the El Greco: (a) blind participant: 'It's realistic with all those details'; (b) sighted participant: 'It represents older times'.

Table 2. Scoring criteria according to the category of open-ended responses to Questions 8–10.

Question 8 What does this painting suggest to you?	Question 9 What do you like or dislike about the painting?	Question 10 What's your opinion of the painting?
0 = No answer	0 = No answer	0 = No answer
1 = Superficial description	1 = Characters, figures	1 = External elements/superficial emotion
2 = Relationship with experience	2 = Technique, colour, aesthetic value	2 = Aesthetical analysis, degree of liking
3 = Feelings, emotions	3 = Subject matter	3 = Reasoned analysis
4 = Association of ideas	4 = Similarities	4 = Reflection, judgement, criticism
5 = Opinions	5 = Author, historical or artistic period	5 = Relationship of painter's intention. Effect of painting. Knowledge of author and work

Both blind and sighted participants referred to perceptual elements such as: (1) the music: (a) blind student: 'I liked the music for the woman'; (b) sighted student: 'The music makes you curious about what's going to happen'. Or (2) the location: (a) blind student: 'The sun's not in the right place'; (b) sighted student: 'Misplaced'. Or (3) shapes: (a) blind student: 'It uses straight and curved lines'; (b) sighted student: 'Simple lines'. Logically, only the sighted participants mention colour or contrasts of light and shadow.

The credibility of this qualitative analysis is based on referential adequacy (Lincoln and Guba 1985) across three primary and secondary school visual arts teachers, as mentioned before. Disagreements were resolved by consensus. Amendments were introduced and indicated in order to perform the analysis. On the basis of this analysis of categories, the responses were quantified giving a numerical value (see Table 2). In summary, open blind and sighted responses expressing students' understanding of the work as well as their opinions and taste were similar in quality.

Next, a quantitative analysis was carried out. We first compared the mean scores of the blind and sighted groups for the questions on content (Section Introduction) and artistic appreciation (Section Method) in TEST_1 and then in TEST_2. We also compared the mean scores for content (Section Introduction) and art appreciation (Section Method) between TEST_1 and TEST_2 in order to determine the retention of learning, both in blind and sighted participants. We used non-parametric statistics to calculate possible significant differences in learning outcomes between blind and sighted students and between TEST_1 and TEST_2.

In order to control for prior knowledge about the author and his or her work, blind and sighted participants were both asked whether they knew any of the painter's works of art. The total percentage of affirmative responses in the case of 'The Knight with his Hand on his Breast' was 17.9 and 14.3% for both the 'Picador and 'Woman in Front of the Sun'. These percentages suggest limited prior knowledge, which would confirm that a high percentage of the knowledge acquired after the intervention was an outcome of it.

In order to compare the knowledge acquired through the explanation of each picture, we calculated the total number of correct answers to the six questions (Section Introduction), which could vary from 0 to 6 points in each performance test, depending on the number of correctly answered content questions. By adding the scores for all three pictures, the overall score for content could range from 0 to 18 points. The same procedure was followed for the three open-ended questions on aesthetic appreciation (Section Method), with a maximum score of 15 points in each performance test (see Table 2). This resulted in an overall score for artistic appreciation of the three paintings ranging from 0 to 45.

Table 3. Descriptive statistics of content and aesthetic appreciation completed by blind and sighted participants, in Tests 1 and 2.

Content (scores 0–18)					
Aesthetic appreciation (scores 0–45)	<i>N</i>	Minimum	Maximum	Mean	SD
CONTENT TOTAL SIGHTED 1	21	11.00	17.00	15.29	1.67
CONTENT TOTAL SIGHTED 2	21	12.00	17.00	15.14	1.28
AESTHETIC TOTAL SIGHTED 1	21	10.00	27.00	17.90	4.59
AESTHETIC TOTAL SIGHTED 2	21	11.00	24.00	17.90	3.66
CONTENT TOTAL BLIND 1	7	12.00	17.00	14.29	1.60
CONTENT TOTAL BLIND 2	7	10.00	17.00	13.57	2.51
AESTHETIC TOTAL BLIND 1	7	13.00	26.00	19.14	4.88
AESTHETIC TOTAL BLIND 2	7	10.00	27.00	20.14	5.27



Table 4. Non-Parametric Contrast statistics of the paintings' content between blind ($n = 7$) and sighted ($n = 21$) students for TEST_1 and TEST_2.

	Greco			Botero			Miró			Total		
	(%) Correct answers	Mann-Whitney $U(p)$	(%) Correct answers	(%) Correct answers	Mann-Whitney $U(p)$	(%) Correct answers	(%) Correct answers	Mann-Whitney $U(p)$	(%) Correct answers	Mann-Whitney $U(p)$	(%) Correct answers	Mann-Whitney $U(p)$
TEST_1												
Sighted	84.92	58.50 (.391)	91.26	43.50 (.075)	84.92	84.92	84.92	72.00 (.930)	84.92	42.50 (.090)	84.92	42.50 (.090)
Blind	71.42		88.09		83.33	83.33			83.33			
TEST_2												
Sighted	78.56	36.00* (.035)	87.30	70.50 (.862)	86.50	86.50	63.00 (.547)	63.00 (.547)	86.50	43.50 (.104)	86.50	43.50 (.104)
Blind	59.52		88.09		78.57	78.57			78.57			

* $p < .05$.

Table 3 shows the descriptive statistics referring to content and aesthetic appreciation both for blind and sighted participants and for TEST_1 and TEST_2. Comparing variability between the first test and the test administered one month later, the sighted participants presented a slightly higher variability in the first test and the blind participants in the second one.

In general, the results of the non-parametric analysis (Mann-Whitney *U*-test) showed no significant differences between blind and sighted participants in the majority of the domains analysed. As can be seen in Table 4, the non-parametric contrast tests mostly reveal no significant differences between sighted and blind students either in TEST_1 or in TEST_2 for the content questions. Consequently, the two samples' responses to the content questions were similar. The only exception was in TEST_2 on El Greco's 'The Knight with his Hand on his Breast', where significant differences were found between blind and sighted participants in TEST_2. As shown in Table 4, the percentage of correct answers regarding the content of this painting in the second test (TEST_2) was lower in blind students than in their sighted peers. A careful analysis of the questions about this picture showed that, in reference to the painting style, only one of the blind students obtained the correct answer, referring to its symbolic nature, as opposed to realistic or abstract ones. The other six students chose the alternative 'realistic painting'. Perhaps the touch scan detected the presence of symbolic elements such as the sword, the clock or neck.

With regard to the questions on aesthetic appreciation, quantitative analysis of the responses, scored according to criteria established by a panel of experts, revealed similar results. Statistical contrast analysis (Mann-Whitney *U*-test) found no significant differences between blind and sighted participants in aesthetic appreciation either in the first test or in the one administered one month later.

Additionally, to determine whether learning about content and aesthetic appreciation is maintained over time, we analysed separately the differences between Tests 1 and 2 for both the samples of blind and sighted participants. The Wilcoxon signed-rank test found no significant statistical differences between the results for the two tests in the two samples either in content or in aesthetic appreciation of the three paintings.

Discussion and conclusions

Our results show that both sighted and blind students adequately learned the content about the three proposed paintings and could express aesthetic appreciation of the works of art. The content referred to knowledge of the painter, general artistic style, technique and subject matter. This content matches the recommendations of the official art education curricula. We used an inclusive approach. Intervention was the same for blind and sighted students, as recommended by Eisenhauer (2008a), (2008b) and Derby (2011).

Broadly speaking, no significant differences were found between blind and sighted students in scores for content and aesthetic appreciation, for any of the three paintings. Furthermore, our results revealed no significant differences between learning scores in the post-presentation test conducted one month later. Consequently, learning was maintained. The only significant difference was found in the case of El Greco, where blind students showed less recall of content one month after the teaching session.

These results suggest that learning of content and aesthetic appreciation is similarly maintained both by blind and sighted students.

Our findings provide scientific evidence supporting the first experiments conducted in museums regarding access to visual arts (Axel and Levent 2003; Muñoz 2007; González 2008). Recent studies such as that by Kamei-Hannan, Holbrook, and Ricci (2012) again advocate access to content and learning processes through verbal instruction.

Regarding the use of support based on tactile perception, such as tactile diagrams of fuser reproductions, we followed the recommendations of Cela (2002), who favours this type of presentation due to its enhanced schematic nature. More recently, authors such as Zebehazy and Wilton (2014b) have highlighted the importance of training teachers in the use of tactile graphics in school environments.

The need for an art education programme specifically focused on the appreciation of pictorial works for visually impaired students was previously addressed by Koenig and Holbrook (2000), the PAVE project by Corn et al. (2003), and the IDEA programme, applicable to students with any type of disability (LaVenture 2003). Verification of real learning regarding content and aesthetics by blind students and their sighted peers in a school setting coincides with the ideas of Lohmeier (2005), who argues that instructional programmes for students with visual impairments require an expanded curriculum both for intra- and extra-curricular areas.

Regarding adaptations in mainstream schools, the results of our study coincide with those of Douglas et al. (2011), who propose measures to increase access, the teaching of access skills in the classroom and curriculum adaptations. As suggested by Kamei-Hannan, Holbrook, and Ricci (2012), coordination among professionals is required to provide the most suitable conditions of access. This was achieved in our study by the ONCE, which administered the intervention in the five provinces of the region of Castilla-La Mancha. The role of these teaching assistants is to provide learning support and teaching access skills, as well as to provide accessible material, in the sense of Douglas et al. (2011).

Following the proposals of Lusk, Lawson, and McCarthy (2013), the intervention designed for this study used new technologies and instructional methods. We used sounds about the scenes depicted in the pictures, taken from digital sound banks, as well as audio files of music from the different art periods, which were played during the verbal information stage and while participants explored the tactile diagrams of fuser reproductions with their hands.

This study has initiated a line of research and development that should be expanded by increasing the number of participants in the sample. The different parts of the intervention programme should be analysed to verify their differential effectiveness: for example, the auditory input of sounds related to the scenes, the music of the period, as well as other forms of tactile stimulation or oral explanation of the pictures, comparing blind or visually impaired students and their sighted peers.

The visual stimuli are faithful to the reality represented, with the exception of reducing the size to be represented on canvas. In view of this, the tactile stimulation could also be reduced to a material easily explorable by the hands. Designing volume material to be touched would be a good attempt to obtain a stimulus similar to the represented reality. This material could be used for training in order to achieve a spatial representation from touching small figures. The representation of mental images either from visual or tactile stimuli would depend on the subject's cognitive capacity. This point should be investigated to determine whether the quality of the representation has the same power in blind students as in the sighted ones.

Referring to the two different approaches – expanding the curriculum and teaching access skills vs. providing accessible material – in this study, we dealt with both aspects. Tactile material substituted visual material to represent the main figures of the paintings. Nevertheless, all the students received the same narration and scenic sounds, which is an example of expanded curriculum. Including the intervention in strategies to deepen the meaning of the topic of the painting, the painter's intention, reflections about liking or disliking, feeling emotions, etc. is an example of inclusive practice.

Following Douglas et al. (2011), through attention to teaching strategies, art education can be made more inclusive. Access to a shared curriculum could be a significant teaching strategy to provide more inclusive practice in the school context, not only for students with a specific disability but also for typically developing students. All the teachings could gain from attention to accessible and multi-modal strategies.

In conclusion, in the present study, qualitative results support the quantitative findings, showing that the teaching method used is valid to understand and appreciate art works, both for the blind and the sighted. The method is characterised by its inclusivity, as it is directed at both blind and sighted students, using visual and tactile material (illustrations and tactile diagrams of the paintings) as well as verbal descriptions, synthesised sounds about the scene depicted and music from the artistic period of the picture presented. Instruction was provided to obtain knowledge of the author, technique and subject, but without ignoring aesthetic appreciation, transmitted through use of music and the opportunity to reflect on the experience.

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