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Dialogic scientific gatherings with mothers and teachers from a primary school: raising awareness about the impact of gender and education research

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Social science unveils new ways of engaging communities in science. However, it has not yet been analysed how dialogic scientific gatherings (DSGs), a community science action, involve communities to benefit from the research on two sustainable development goals: quality education and gender equality. Within the framework of the EU H2020-funded project "ALLINTERACT Widening and diversifying citizen engagement in science" (Flecha and ALLINTERACT Consortium, 2020), the DSGs on evidence in preventing violence and gender violence through education have been replicated to engage a group of 10 mothers from a low-middle socioeconomic background whose children attend the same neighbourhood school and two teachers. The participants' perception of the DSGs' replicability has been studied through focus groups. The first one was a pretest FG aimed at collecting the previous perceptions of the participants about their awareness of the scientific research benefits and impact and their previous engagement in science. The second round was a posttest FG after participating in the DSGs, which consisted of 11 sessions in which participants selected scientific articles to read and discuss together. The posttest FG explores changes in participants' perception regarding the topics discussed in the first round and analyses how the replicability of the DSGs aimed at community participation in science developed. The main findings show that after participating in the DSGs, participants reported more awareness related to scientific research benefits and impact, increased involvement in science, greater understanding of the social impact of scientific evidence in preventing violence and gender violence through education, and more engagement in social issues for the improvement of their community. The implications for the replicability of DSGs as community science action are as follows: 1) The topics to be read must be based on the participants' interests, and 2) the dialogical functioning criteria must be ensured.

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Introduction

In response to society's demand, science has begun to reorient itself towards dialogue with social sectors and individuals who have not been included until now, developing a new cocreation process of knowledge (Flecha, 2021). Nonacademic women have traditionally been excluded from participation in science (Beck-Gernsheim et al., 2003; De Botton et al., (2006)). In the knowledge about community science research, understood as the development of research models to improve the quality of life in communities, involving the community acquiring scientific knowledge and decision-making processes, studies have mainly focused on health promotion, including a significant number centred around women. (Chrisinger et al., 2022; Hawkins et al., 2021; Higuera-Mendieta et al., 2023; Lindsjö et al., 2021). From what is known as citizen social science, the focus of scientific research in the humanities and social sciences conducted in cooperation between professional and nonprofessional researchers is being expanded to include the analysis of cooperative interactions between social science researchers and other social actors outside academia, such as schools and civil society organisations (Göbel et al., 2022). In this vein, for more than two decades, studies developed through the communicative methodology in the framework of the dialogic theory of social sciences (Ramon Flecha, 2022; Soler Gallart, 2017) have included nonacademic women, those who have been left out of the spaces of public debate and decision-making because they do not have university degrees, in the whole process of research on social issues that benefit themselves and their communities (Aiello et al., 2022; Beck-Gernsheim et al., 2003; García Yeste et al., 2011; Gómez et al., 2011).

While it is true that the number of community science projects has increased significantly over the past decade, few studies have analysed the motivations not only of nonacademic women but also of all citizens to become involved in science (Alender, 2016; Raddick et al., 2013; Reed et al., 2013) or the citizens' awareness about the benefits of science or community science research (Brown et al., 2012). Some authors have demonstrated that many citizens still need to see why they should understand or participate in science but are willing to participate when they become aware of the social impact of research results (Flecha, 2021). Within the framework of the dialogic theory of social sciences (Ramon Flecha, 2022; Soler Gallart, 2017), scientific dialogic gatherings constitute a community science action that has been proven to engage groups that traditionally do not participate in science (Buslón et al., 2020; Díez-Palomar, 2020; Díez-Palomar et al., 2022).

Dialogic Scientific Gatherings as a Community Science Action

Dialogic scientific gatherings (DSGs) create a learning environment for the collective construction of meaning and knowledge based on dialogue among participants. Through DSGs, the direct approach of citizens without distinction of age, gender, culture, or educational level to scientific knowledge is promoted. DSGs can be about any scientific content and any of its applications. DSGs are based on dialogic learning (DL), which was theorised by Ramon Flecha 17 years after he created the first dialogic gathering (Ramón Flecha, 1997, 2000). DL is in line with social science conceptions that all have interactions as the basis of learning and the premise that all people have the capacity for language, reflection and action regardless of their age, gender, culture, or academic background (Bakhtin, 2010; Beck, Giddens, & Lash, 1994; Bruner, 1996; Chomsky, 2006; Ramón Flecha, 2000; Freire, 1970; Habermas, 1981; Mead, 1934; Vygotsky, 2012). In DSGs, the scientist or academic does not teach the participants what they do not know. Instead, through reading a scientific text, they all discuss its meaning, the ways in which this knowledge has contributed to scientific and social progress and the benefits it has brought to people's lives and to their own. DL (Flecha, 1997, 2000) consists of seven principles: 1) egalitarian dialogue, as participants' contributions are considered valid because of the arguments on which they are based and not because of the position of power of the person making the contribution; 2) cultural intelligence, which encompasses academic, practical and communicative intelligence, the knowledge that is created in dialogue with other people; 3) transformation, as the focus is on transforming the relationships between participants and their communities, helping to overcome social inequalities, for example, between those who have higher academic degrees and those who do not; 4) instrumental dimension, which includes all the scientific knowledge that is considered necessary to learn, overcoming the "technocratic" imposition in which only the scientist/expert knows; 5) creation of meaning, as all people can create meaning based on the scientific knowledge discussed when it contributes to enrich the reflexions and decisions that improve the lives and communities of the participants; 6) solidarity, as participation is open to all types of people without any economic or academic barriers, and priority in the dialogue is given to those who have not yet participated; and 7) equality of differences, as the equality of all participants lies in the equal right to live and think differently. In this article, when the terms debate and discussion are used as synonyms for dialogue, it is always from the same conception of these seven principles.

Some qualitative case studies have shown the impact of DSGs involving children and adults (Buslón et al., 2020; Díez-Palomar, 2020; Díez-Palomar et al., 2022). One of these case studies analysed the impact of the DSGs on science literacy and community science action in a class of 10-year-old children in a primary school in Tarragona, Catalonia. After the development of 6 sessions in which children read and discussed scientific articles on the human genome, climate change, and bees' learning abilities, participants reported that they better understood scientific concepts, acquired new vocabulary, developed analytical and critical thinking and improved their ability to bring arguments to the debate and that supportive interactions between children were promoted (Díez-Palomar et al., 2022). Another case study was developed with 11 adults (55–70 years old) with low educational levels who participated in an adult school in Barcelona. During several academic years, they read and discussed in DSGs "Letter to Grand Duchess Christina" by Galileo, "De rerum natura" by Lucretius and scientific articles published in prestigious journals such as Nature related to issues such as health and diet linked to lower risk of cognitive decline, obesity, neuroscience, and healthy brains, as well as to environmental and sustainable development topics such as ocean warming, climate change and water policy, and science versus political realities. In their narratives, the participants reported how the DSGs had made them more aware of the importance of making evidence-based decisions to improve their lives and health and contribute as citizens to societal challenges (Buslón et al., 2020). A third case study was conducted with women with low educational levels and participants in the same adult school. This study aimed to analyse how they engaged in critical thinking on numeracy reading involving units of measurement, number systems, and the concept of base. Through the observations of the DSGs and the participants' narratives, it was identified that these women unravelled the mathematical meaning implicit in the readings, critically examining the objects discussed and generating interest in mathematics (Díez-Palomar, 2020).

ALLINTERACT project

ALLINTERACT is a project funded by the European Union's Horizon 2020 scientific research programme (Flecha and

ALLINTERACT Consortium, 2020). The project has two general goals: on the one hand, to create new knowledge about how to transform potential citizen participation in science into actual engagement in scientific research, and on the other hand, to unveil new ways to engage societal actors, including groups that have traditionally been excluded from science. This project is based on the idea that although many citizens still need to see why they should understand or participate in science, they are willing to participate when they become aware of the social impact of research results (Soler-Gallart and Flecha, 2022). In this vein, previous research has shown that if citizens are aware of the social impact arising from research, they are more likely to become involved and participate in science (Flecha, 2021). The ALLINTERACT project focuses on two Sustainable Development Goals: quality education and gender equality.

The study presented in this article is one of the cases that is part of the work carried out by the University of Barcelona (UB) team in Work Package 5, "Replicability of actions aimed at citizen engagement in science", the goal of which is to study the replicability of the actions aimed at citizen engagement in science, as well as to analyse citizen awareness of scientific research, their engagement in science and the promotion of their participation, and their attitudes towards science.

In this case, the UB team has been selected as an action to replicate the Scientific Dialogic Gatherings, a community science action for which scientific evidence of its potential to engage new citizens in science is available. Notably, the team has replicated this action with women from a low-middle socioeconomic background whose children attend the same neighbourhood school and two teachers from this school to answer the following research questions:

Research question 1: What are the participants' perceptions of the replicability of the DSGs aimed at community participation in science?

Research question 2: How have the DSGs influenced participants' knowledge of scientific research and their engagement with science and encouraged their participation and attitudes towards science?

Methods

The participants' perception of the replicability of the DSGs was studied through two rounds of focus groups (FGs). The first round was a pretest FG. The second round was a posttest FG after participation in the DSGs, which consisted of 11 sessions in which the participants selected scientific articles on gender and education to read and discuss together, was completed Fig. 1. In the last phase of the development of the study, it was decided to include in the analysis the intervention that one of the mothers participating in the DSGs and the pre- and posttest prepared for the final conference of the ALLINTERACT project at the European Parliament in Brussels. In this intervention, she related her perceptions of the impact of the DSG on herself, her children, the school, and her neighbourhood.

The study context and participants. The Casablanca school, where the DSGs were replicated, is a public school located in a low socioeconomic background neighbourhood of a city within the metropolitan area of Barcelona, Sant Boi de Llobregat. This school provides preschool education (3–5 years) and primary education (6–12 years) and has approximately 450 pupils, with a high percentage of children from immigrant families from Morocco, various Latin American countries, and Eastern European countries, mainly Romania. In the 2018–2019 academic year, Casablanca School decided to join the network Schools as Learning Communities. These schools implement educational actions based on evidence of social impact on learning and coexistence (Flecha and Soler, 2013; Rodríguez-Oramas et al., 2022).

Everyone participated voluntarily in the DSGs. The conversations between the researchers and potential participants about the possibility of involvement in the research occurred in locations where the participants felt comfortable and safe to avoid any possible coercion and to ensure that the decision was made with absolute freedom. The researchers informed the participants that they would not receive any reward or face any costs for participation. The recruitment process was never conducted by anyone who could unduly influence potential participants. The language employed ensured the participants' comprehension. All of the participants received written and oral information about the project and signed a consent document, translated into the national language, to participate.

Although the DSGs replicability case was not specifically targeted at women when families were introduced to the ALLINTERACT project, only mothers decided to participate. Ten mothers and two teachers ultimately participated in the project (see Table 1).

Pretest focus group. The pretest FC was conducted in October 2021. It focused on five topics that correspond to the objectives of the ALLINTERACT project: a) how citizens benefit from scientific research; b) citizen awareness of the impact of scientific research; c) awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the open access movement; d) awareness-raising actions that foster the recruitment of new talent in sciences; and e) policies that promote awareness-raising actions and citizen engagement in science.

In developing the pretest FG, the researcher held the role of facilitator and was responsible for giving turns to the participants who wanted to intervene in the discussion. To help everybody participate equally, the facilitator always prioritised those participants who had intervened less and encouraged everyone to join the conversation and ensure an egalitarian dialogue among them (Gómez et al., 2011). The discussion was audio-recorded and transcribed, and all names were replaced with pseudonyms for the analysis. Later, the transcriptions were translated into English.

The intervention: dialogic scientific gatherings. DSGs constitute a community science action aimed at promoting citizens' interest and engagement in science, especially among those groups that traditionally are not involved in it (Buslón et al., 2020; Díez-Palomar, 2020). The DSG intervention consisted of 11 sessions developed from November 2021 to June 2022, approximately one per month, although three sessions took place two weeks apart. The participants decided on the day and timetable, so the intervention took place on Fridays, starting at 15:10 and lasted

Fig. 1 Methodological design of the research study. Pretest and posttest focus group after participation in the DSGs.

between 45 and 60 minutes. All DSG sessions were held at the social centre in front of the school to respect the COVID-19 government regulations for the 2021–2022 school year.

Within the framework of the ALLINTERACT two general objectives: (1) to create new knowledge on how to transform the potential participation of citizens in science into real engagement in scientific research, and (2) to unveil new ways of involving citizens in science, including groups traditionally excluded from science, specifically in scientific research for quality education and gender equality, the articles were selected according to the topic that the mothers had chosen to work on, fulfilling one of the criteria for the functioning of the DSGs. The mothers and teachers met before the DSGs to decide on the theme for the readings. The sole criterion of the ALLINTERACT project for selecting the topic was that it had to directly affect their children's academic performance and the school climate. The participants decided to focus on preventing violence and gender violence through education. The research team (with a substantial background in research on education and gender) selected a list of papers in peer-reviewed journals indexed in the Social Science Citation Index of the Journal Citation Report on the Web of Science and in the SCImago Journal Rank indicator on the Scopus database, as well as studies published by public institutions such as the Spanish Ministry of Education and the European Union. The inclusion criteria for the papers were that they presented evidence of the social impact of educational actions aimed at preventing violence and gender violence in schools and communities. The participants then decided which of these papers would be read. As the DSGs were being carried out, the participants also decided to which studies they should dedicate more than one session to deepen their contributions. Due to the interest generated, they even decided to reread some of them later, such as the one dedicated to one of the educational actions that promote zero violence at school from the active positioning of the bystanders. Finally, six papers were read and discussed in DSGs. All were open access distributed in the 11 sessions (see Table 2). The five papers originally published in English were translated into Spanish using an online neural machine translation service and subsequently reviewed by the researchers. They were then distributed in paper format to the participants with the help of the teachers involved.

Before every DSG session, the participants and the moderator (a researcher) read the agreed-upon pages. They selected interesting paragraphs that they would like to share in the DSG session. Three female researchers from the team had the role of moderators. The three moderators ensured that the participants complied with dialogic learning principles in all the dialogues in the DSGs. At the beginning of each DSG session, the moderator introduced the selected article by summarising its main contributions and some points for the debate. Later, the moderator opened the floor, and the participants intervened. The moderator wrote a list of interventions for participants wanting to intervene. Each time a participant intervened, "with the article in hand", they began by mentioning the page and section of the paragraph/sentence they had selected, reading it, and then sharing their reflection. Although the reflections are not from experts, they can express what has been raised, explain why it has attracted their attention, relate it to previous dialogues in past gatherings, critically reflect on it, or connect it to their daily lives. The moderator then asked if someone else wanted to add anything to that idea and listed those wanting to intervene. Once there were no more comments regarding the first idea shared, the moderator gave the floor to the next participant in the list.

Posttest focus group. The second round of the focus group, posttest FG, was conducted in July 2022 to identify changes in the same five topics of the pretest FG after participation in the DSGs. At the same time, the goal of the posttest was to study the participants' perception of the replicability of the DSGs in this specific group. To this end, the objective of identifying how the principles of dialogic learning are behind the effects on DSG participants was added. The posttest FG lasted approximately 30 minutes and was distributed in one session. For the posttest FG, the researcher who conducted the pretest FG contacted the participants who had participated in the DSG to ask them if they wanted to participate in the posttest FG. In the case of posttest FG, four of them were able to join. Three of the participants (Elena, Adriana, and Bianca) were mothers, and one was a

Table 1 Participants' profile.

Pseudonym	Profile	Gender	Age range	ISCED*
Carmen	Teacher	Female	40–44	L5
Lucia	Teacher	Female	55–59	L5
Elena	Mother	Female	45–49	L1
Laura	Mother	Female	30–34	L3
Angela	Mother	Female	45–49	L3
Adriana	Mother	Female	40–44	L5
Victoria	Mother	Female	40–44	L3
Nerea	Mother	Female	40–44	L3
Bianca	Mother	Female	40–44	L3
Estefania	Mother	Female	40–44	L3
Carolina	Mother	Female	35–39	L5
Matilde	Mother	Female	30–34	L2

* International Standard Classification of Education (UNESCO Institute for Stadistic, 2012): NBS = No basic studies; L0 = Preprimary education; L1 = Primary Education 1-6; L2 = Lower Secondary Education 1-4; L3 = Upper Secondary Education 1-2; L4 = Postsecondary nontertiary education; L5 = First stage of tertiary education 1-3/4; L6 = Second stage of tertiary education ½.

Table 2 Papers read on each DSG session.

Session	Topic	Reference
Session 1	Preventive socialisation of gender violence and new alternative masculinities	Duque et al. (2015)
Session 2		
Session 3	The effects of technology use on children's empathy and attention capacity.	Flecha, Villarejo, Pulido et al. (2020)
Session 4		
Session 5	Isolating Gender Violence.	Vidu et al. (2021)
Session 6		
Session 7	The Zero Violence Brave Club: A successful intervention to prevent and address school bullying.	Roca-Campos et al. (2021b)
Session 8	Intervention study for the prevention of gender-based violence in adolescence.	Racionero-Plaza et al. (2019)
Session 9	Friendships and the impact of the new alternative masculinities on health.	Ríos-González et al. (2021)
Session 10	The Zero Violence Brave Club: A successful intervention to prevent and address school bullying.	Roca-Campos et al. (2021b)
Session 11		

Table 3 Categories of analysis.

Session	Categories
Pretest FC	a) How citizens benefit from scientific research
Posttest FC	b) Citizen awareness of the impact of scientific research
	c) Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement
	d) Awareness-raising actions that foster the recruitment of new talent in the sciences
	e) Policies that promote awareness-raising actions and citizen engagement in science.
Posttest FC	f) Study of the replicability of the DSG: Changes in awareness, encouragement of active engagement and attitudes from potential engagement to actual engagement in science.
	g) Study of the replicability of the DSG: Principles of dialogic learning

teacher (Lucia). The others were unable to participate due to different personal circumstances. The discussion process was the same as that for the FG pretest. The posttest FC was audio-recorded, transcribed and translated into English. All names were replaced with their pseudonyms.

Analysis categories. The analysis included the categories referring to project topics (a-e); for the posttest FG, the categories of analysis f and g - cross-cutting in all other categories - were also added (see Table 3). To this end, the four researchers independently analysed and categorised the pre- and posttest FG data. Then, the analyses were triangulated, and a consensus was reached in cases with a mismatch. The analysis was then sent to the participants for feedback to ensure that their perceptions were correctly analysed.

Results of the pretest focus group

How citizens benefit from scientific research. In the pretest FG, the participants, especially those without higher education, reported little or no contact with scientific research. Some reported being aware of benefits from science in situations related to the health of themselves, their families and their community. Only one of the mothers, Angela, reported benefits from science in her work as a nursing assistant in a psychiatric institution. She stated having benefited from the scientific research results on mental illness through the lectures given by psychiatrists and educators to the rest of the professionals working at the centre. This scientific knowledge gave her more capacity to respond better to specific patient situations. Only in the cases of the two female teachers were they aware of benefiting from science in promoting gender equality and education; both had previously participated in DSGs aimed at teachers.

Awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement. The participants shared the view that there is a need for initiatives that provide scientific evidence on issues that directly affect the lives of people who, like them, are not generally involved in science. However, they all stated receiving much information through the media and social networks on health, gender equality and education. However, they did not know how to check what information was based on scientific evidence and what was hoaxes, fake news, or misinformation. For example, Nerea mentioned foods advertised as healthy when they are not because it is hidden in the ads that they contain a lot of sugar. She affirmed needing to learn how to verify all the information received. She said: *So where can I find that this information is correct?*

Regarding initiatives that promote awareness-raising and engagement in science, the participants reported a few examples with which they were familiar that were related to health, but there were none on gender and education. Two of the mothers had participated in fundraising for the fight against childhood cancer through the school's Family Association after attending a talk organised by an NGO. Two others, Elena and Nerea, reported participating in two clinical studies as patients.

Awareness-raising actions that foster the recruitment of new talent in the sciences. The participants stated that they had few opportunities to take their children to science activities to increase their awareness of science and scientific careers or, if such activities had been organised, the information had yet to reach them. Only Bianca, one of the mothers, explained a project on women scientists developed by one of the female teachers at the school. As a result of participating in this project, Bianca's daughter was interested in developing a career as a scientist.

Policies that promote awareness-raising actions and citizen engagement in science. The group of participants agreed that there is a need for policies and initiatives to promote public awareness and involvement in science, mainly aimed at groups that do not usually have opportunities to participate in science, such as some of them and their children.

Results of the posttest focus group

The findings of the posttest focus group show the changes in awareness, encouragement of active engagement and attitudes from potential engagement to actual engagement in science and cross-sectionally reveal how the principles of dialogic learning have successfully enabled the replicability of the DSGs.

Changes in awareness of how citizens benefit from scientific research. Regarding the posttest FC, which was conducted after all the DSGs sessions on articles about violence and gender violence prevention through education, the participants emphasised that they felt it was beneficial to know what scientific evidence was applied in the different school cases to reflect on their own experience. The prevention of violence and gender violence was one of the issues that most concerned the participants, which is why they chose this topic for the DSGs. The participants recognised that participating in the DSGs benefited them by helping them more deeply understand the reality around them. Lucia explained this in the posttest FC: *The DSGs make us socially aware of what is happening around us (…) That helps you become more aware of the realities that exist.*

On the one hand, the participants experienced a sense-making process, principle five of dialogic learning, about the benefits of these studies. They discussed and reflected on how it could benefit themselves, their families, and their school. On the other hand, principle four of dialogic learning, the instrumental dimension, can also be identified. The participants learn about educational actions based on scientific evidence of social impact on overcoming school violence. For example, Adriana, one of the mothers, acknowledged that they have learned from reading and dialoguing scientific articles about the benefits and improvements

of other schools that have implemented educational actions based on social impact evidence, and it has made them reflect. She explained this as follows:

You can always keep something good from each site when discussing different schools. It is a way of learning from each other that what one does is not always the best. When you read things that benefit others, it makes you rethink things, too, you know?

The main difference before and after participating in the DSGs was that previously, the few mentions that the participants made of the benefits of science were related to health topics and made without considering the scientific research leading to them. In contrast, in the posttest, some of the contributions from the mothers included a recognition of the benefits that scientific research in nontraditional sciences, such as gender and education, could have in schools and their lives, as described in the following subsection.

Changes in citizen awareness of the impact of scientific research. Overall, in the posttest FG, awareness of the impact of scientific research increased. More comments from the participants were seen in this category because they had read the scientific papers behind the benefits of the prevention of violence and gender violence through education of which they were already aware. Most of the participants emphasised how knowing the scientific publications (by reading and discussing them) made them aware of the impact of scientific research. Another significant change was related to the increased awareness of the impact of scientific research, specifically on gender and education but also about the research behind those impacts. For instance, some mentioned becoming aware of research on the effects of technology use on children's empathy and attention capacity after learning about scientific research on the topic in detail. Adriana, one of the mothers, commented that this paper and another on isolating gender violence were the ones she liked the most. The first paper mentioned by this mother is a literature review on the impact of technology use on children. One of the issues it addressed was cyberbullying. The fact that research on the causes of cyberbullying and measures for its prevention was collected in this paper helped the participants better understand how the research is essential to identify the origin of the problem to prevent it. This mother explained that knowing the actions for the prevention of cyberbullying and isolating gender violence based on scientific evidence gave her a feeling of hope: *the article that I liked the most is the one on Isolating Gender Violence and the one on the use of technology. I was hopeful that, in the end, not everything* was so wrong. The dialogue among the participants about the causes of bullying and the actions to prevent it transformed their perspective into a more hopeful one. Transformation is the second principle of dialogic learning. Before the DSGs, some of the mothers had a fatalistic perception that bullying was increasing in schools and that nothing could be done to eradicate it.

The participants' awareness about the impact of scientific research could also be identified in the scientific concept of Isolating Gender Violence (IGV), which was mentioned several times during the posttest FG addressed in one of the papers they read. Isolating Gender Violence is violence against those who advocate for gender violence victims. Such violence aims to isolate gender violence victims and discourage reporting or receiving support to maintain the aggressor's impunity. The IGV concept is linked to what science and legislation establish as gender violence (Vidu et al., 2021). The article concluded that if policies are not adopted to prevent IGV by defining measures for the protection of those who support victims of gender violence, the latter will not be overcome. This article also identifies that for a woman to move from being a victim to a survivor of gender violence, she needs to have a support network. However, this support is often not given because of the fear of retaliation by the aggressor, whose aim is to isolate the victim from any support, hence the need to implement measures to protect those who support victims. By reading and discussing this paper, the participants learned about the concept of IGV and could identify it in their own experiences or real situations with which they were familiar. Lucia, one of the teachers, explained this as follows:

The reading that I liked the most is that of Isolating Gender Violence. It is the one that contributed the most to me because then I heard about that term. Then, of course, you say wow when you know and hear something! You quickly link knowledge with reality.

In the dialogue about the IGV article, meaning creation occurred again for Lucia and the other participants. In the DSGs, they identified the social impact of the research results, seeing the effect such research could have on their daily lives and society. One of the issues in which they were most interested was that of the concept of IGV (a research result) having a political impact. The article noted that this concept had been included for the first time in legislation for eradicating gender violence, the Catalan Legislation 17/2020, of December 22, modification of Law 5/2008 of the women's right to eradicate violence against women. Lucia expressed this when she read the paper and became aware of it:

And then I remembered. I said that Catalonia was the first country to legislate on that, and there was talk of its importance. That this issue has been included in the legislation is a significant advancement in overcoming gender violence and, ultimately, in violence prevention in general.

As another example, the participants could identify what research led to the action they were participating in, the DSGs. In one of the papers they read, there was a reference to a discussion of scientific articles on gender violence and its prevention. In the posttest FC, Adriana reported that at the beginning, she found it difficult to understand a scientific paper. However, the motivation grew through creating sense when participating in DSGs on articles dealing with topics that could affect their and their children's lives. Therefore, Adriana, reading that paper, realised that she was reading about the research process and the evidence behind a case study where they also developed DSGs as an intervention: *It is true that sometimes all that stuff about methods when reading scientific articles seemed very cumbersome to me. In addition, reading an article and participating in dialogic scientific gatherings, I said, "Oh look, if that is what we do in gatherings.*

In several of the contributions made by the participants in the posttest FC, they referred to the fact that in the DSGs, they learned to be aware of the difference between opinions and scientific evidence. The instrumental dimension of the learning process in these DSGs is identified here. For example, Bianca referred to this as one of the things she found most interesting about the DSGs, as she explained:

The most exciting thing is the scientific evidence. The concrete, real case studies on which they are based. These are scientific studies, and from here, you see that they are not only stories or opinions commented on out there. These are genuinely from the point of view of science and the groups that are studying.

Another example was provided by Adriana, reflecting on the DSGs, who noted that this activity not only made them aware of the causes of violence and gender violence in the reality that surrounds them and their families but that by reading and discussing the articles, they were also aware that the statements presented in the papers were not opinions but scientific evidence: *Yes, I think so, dialogic scientific gatherings lead us to become socially aware of what is happening to us, because as you read, you see the different opinions, well, not are opinions, are scientific contributions.*

In addition, some of the participants stated that this awareness was linked with gaining more freedom in their everyday lives and motivation to become involved in social issues. The dialogues in the DSGs on the scientific evidence of social impact in the prevention of violence and gender violence fostered a commitment as citizens to transformation, another of the principles of dialogic learning, specifically in overcoming this social problem. Lucia expressed her awareness of how the DSGs on violence and gender violence prevention had contributed to her being a more active educator in addressing these issues and more motivated to become involved as a citizen:

Of course, the DSGs are hopeful and good things that make you feel more active in your profession and as a citizen. I think this is what is important. (…) However, I am motivated by the subject because I see that I learn and there is also a social impact, and when one learns more, one is more aware. The more aware you are, the more you want to get involved in society, and therefore, learning also gives you more freedom, you know? It makes you freer because you know more and have more options.

Changes in the perception of awareness-raising initiatives succeeding at engaging citizens in scientific participation, including the Open Access movement. As reported by the participants in the posttest FG, the DSGs were an awareness-raising initiative that engaged them in scientific research directly through reading and dialoguing open-access scientific papers. Several mothers, as well as the teacher, noted in the posttest FG that one of the aspects that most influenced their motivation to continue participating in the DSGs was that they were very diverse in age, academic and cultural backgrounds and could have different opinions but that all contributions were valued, in addition to the fact that they all learned from each other. This aspect is related to two of the dialogic learning principles: equality of differences and egalitarian dialogue. Elena said in the posttest FG that the DSGs had helped her understand the different points of view: *I understood the different points of view of the people there since we were of different ages and cultures*.

The participants acknowledged that after attending the first sessions of DSG, they were no longer afraid of reading scientific articles. Lucia, who had had contact with the academic world as a teacher, only read articles presenting scientific evidence of social impact once she participated in DSGs. She affirmed that *it is easier to read scientific papers in DSGs*. Knowing first-hand scientific evidence and being able to understand it through egalitarian dialogue made them want to participate in more scientific gatherings. At first, some admitted they were reluctant to participate in DSGs; however, many changed this view. When the researcher asked how the DSG had benefited them, Adriana said they were now much more confident because they got used to the vocabulary. Each article felt more accessible than the previous one, although they were not. In addition, she reported that the DSGs made them more reflective not only in that space of dialogue but also in their daily lives:

Well, I think not to be so afraid when reading things that, at first, we did not understand or that you had to read or reread, right? Well, in the last readings, it just happens [understanding]; it is not that they were more accessible, but that we were more used to the vocabulary. I do not know; it was simpler, and to reflect more on the day-to-day, it does not only happen in the gatherings. It has helped me be much more reflective on a day-to-day basis. Yes, yes. It is easier to read scientific articles in the gathering.

Even mothers with a degree in primary education stated that thanks to the DSGs, where the contributions of these articles and reflections on their social impact were shared through egalitarian dialogue, they were motivated to overcome the challenge of facing these readings. Elena said that reading together served as a goal to try because when they read alone, *they read at their own pace, but when you read with more people, you are forced to read it. Therefore, it is like you have milestones*.

Bianca responded that she had been able to attend university in her home country, Romania, and therefore had the opportunity to participate in scientific debates on education-related papers. It is significant that in the pretest, she did not make this contribution, probably because she did not identify scientific research with nontraditional fields such as education. She claimed that with the DSGs, through egalitarian dialogue, she regained the interest in science that she had to give up when she had to migrate to Spain:

Well, I was practically used to this type of discussion of research. I had a period in college when I studied in my country, Romania. This meeting with all the women from these gatherings has been like a wow! A breath of new air. Enjoy again, right? to effectively enjoy the ideas and how each one sees these studies.

Not only did this DSG encourage the participants' interest in scientific research, but some also explained the experience in forums attended by teachers and families from other schools, generating significant interest among the attendees. Lucia, one of the teachers, explained their experience with the DSGs at a national forum where hundreds of people were involved in the Schools as Learning Communities project. This presentation reflected the cultural intelligence of participant teachers and mothers, from the knowledge acquired in the chain of dialogues created among them, and explained the functioning and the impact it had on them and the school. The experience generated much interest from teachers and families who wanted to replicate the experience in their schools. Lucia explained this in the posttest FG:

This year at the Schools as Learning Communities Conference, we presented the dialogic scientific gatherings—the experience we had this year. I shared the PowerPoint we did with them, and some people were especially interested because, of course, we talked about the impact on the neighbourhood and the impact that it has had on all of us.

In the posttest FG, Adriana highlighted that if DSGs were replicated in more schools, it would benefit the people who could participate and society. She explained:

That we can be in one way or another, in other people's mouths, well, if this makes each Learning Community or other schools consider doing similar things, well, that we all have won, right? At the level of society and everything. Therefore, this is great.

Changes in the perception of awareness-raising actions that foster the recruitment of new talent in the sciences. Before participating in DSGs, only two participants mentioned that they were aware of initiatives fostering young talent in science. Two mothers knew of an initiative that showed women scientists at school, which had an impact, at least on Bianca's daughter. In the posttest FG, this mother mentioned it again: *The teacher who had our children started some talks about women scientists' projects for children, and now, for example, my daughter is following this path*.

After the DSG sessions, some of the participants acknowledged in the posttest FG the potential of this community science action regarding recruiting new scientific talent. The participants saw the DSGs as a space to promote new people's interest in science, not only for them but also for children or other people not yet involved in scientific research in their school or neighbourhood. Elena stated that *[DSGs] can generate greater interest in science. I think that there would be more people who would be interested*.

At the time of the posttest FG, the teachers and the participating mothers considered opening the DSGs to the whole neighbourhood and in the classes with the children. Lucia, the teacher, noted how Elena, one of the mothers who was more involved in the DSGs and other initiatives in the neighbourhood, wanted to promote them in the secondary school where her two older children would start the following school year. Both commented on the need to continue with the DSGs for the next school year and to increase participation for more diverse people. Lucia explained this in the FG posttest:

Well, I value it [doing DSGs] very positively as a school and as a neighbourhood because, well, the people in this group are also very involved in almost everything that happens in the neighbourhood, you know? And that goes beyond. I think this is our impact, and Elena leaves school this year, but we say that the gatherings must be open to people from the neighbourhood.

A few months into the new school year, the research team learned that Elena was promoting the organisation of the DSGs in her children's secondary school and continuing to attend the DSGs in the primary school. The mothers and teachers participating in the DSGs have encouraged many others to participate in the DSGs for the new school year 2022–2023. The last DSG developed in this school in February 2023 (when the first version of this manuscript was submitted), already outside this study, involved more than 30 people with very diverse profiles. For the first time, some fathers participated, although most were mothers. Most of these families do not have higher academic qualifications. The team of canteen monitors and two other teachers also attended. During the current academic year, the DSGs have also started with children during school hours. The impact of the DSGs on school community leadership for developing the dialogic model of conflict prevention and resolution in the school during the 2022–2023 academic year is the subject of another study to be published soon.

Changes in the perception of policies that promote awareness-raising actions and citizen engagement in science. No additional mentions were made in the posttest FG about policies that promote awareness-raising actions and citizen engagement in science beyond mentioning that public policies for promoting citizen engagement in science could be designed according to evidence-based social impact actions such as the DSGs. The ALLINTERACT research team invited Elena to the final conference to present the project results at the European Parliament in Brussels on March 27, 2023. At this conference, the results were presented not only by the researchers but also by citizens of all ages who participated in the different Community Science actions developed in the framework of this project. European parliamentarians, policymakers and stakeholders from community science organisations and researchers attended the conference. Here are some excerpts from Elena's speech to the European Parliament that she sent to the research team when this article was finalising. Elena is the mother participant who has had the least educational opportunities and is one of the women promoting the creation of DSGs in her neighbourhood.

Thirty years ago, this school was different. I spent many years in the special education classroom, separated from my classmates. I came to believe that I lacked something to be like everyone else. Thanks to the transformation of Casablanca School into a Learning Community implementing successful educational actions such as Scientific Dialogic Gatherings, I am now confident and empowered to do things for my neighbours and school families. I am president of the families' association of my older children's high school and my youngest child's primary school. I have participated in constructing two women's associations in the neighbourhood. It is clear to me that for the school and the children to be successful and, if they want, to be able to dream of a career in science, we families must be educated and involved in school life (…) One day, when my daughter was in her first year of secondary school, and they were discussing how each person lives their sexuality and that there are homosexual people of different conditions, totally respectable and that we are all equal, my daughter Maria raised her hand and said that she had two mothers and that she was proud of them. A classmate addressed her with disdain (…) Maria told him that if he were willing, they would talk, and so it was later. Although each person may have different ideas, we are all equal, and we must respect each other, and that is a task we must do from a young age (…) Thanks to the DSGs, we are better people and try to take care of and improve the lives of others (…).

In Elena's words, it is possible to identify principle six of dialogic learning: solidarity. The DSGs have impacted not only how this mother is thinking about improving her children's school and their lives but also how implementing educational actions based on evidence of social impact can contribute to improving the lives of all the people in her neighbourhood. Elena had talked a lot with Maria about the topics of the scientific articles they read for the DSGs; her daughter even attended some of them. For example, they talked about what it meant to be a brave person, an active bystander who always takes a stand against all kinds of violence, defending the victims without using violence.

Discussion

Regarding Research question 1: What are the participants' perceptions of the replicability of the DSGs aimed at citizen participation in science? Considering that the researchers ensured the seven principles of dialogic learning in the intervention, the DSGs were replicated in 12 women, 10 mothers and two teachers from the same school for 11 sessions. None of the participants are involved in educational research, and most do not participate in scientific activities. They have different educational levels since primary school, mostly secondary school, and some have a university degree. Due to the egalitarian dialogue that takes place in the DSGs and focusing on the topic that the participants had decided because it affects their lives and those of their children directly, the perception coincides with previous studies in that DSGs are an action that generates interest in science and manages to engage groups that traditionally do not participate in scientific activities (Buslón et al., 2020; Díez-Palomar, 2020; Díez-Palomar et al., 2022). However, this study is the first on the replicability of the DSGs on issues related to the prevention of violence and gender-based violence through education in a group of women where most of them are not involved in education, and some have only secondary or primary education. Other studies have replicated the dialogic gatherings in which scientific papers on education and, among others, the prevention of violence and gender violence have been read with other groups such as teachers. (Roca-Campos et al., (2021a); Rodriguez et al., 2020; Rodríguez-Oramas et al., 2020), women and girls in different settings, such as university students (Racionero-Plaza et al., 2018; Ugalde et al., 2022), adolescents in a minor care centre (Salceda et al., 2020) and girls with intellectual disabilities in a special education school (Rodrigues de Mello et al., 2021). Coinciding with the contributions of these studies, the participants in the present study reported in the posttest FG that participating in the DSGs developed in them a creation of sense in learning about the scientific evidence on educational actions that prevent violence and gender violence, contributing to a type of reflection that enables new knowledge and skills to identify and prevent it in their own lives. These reflections that emerge from the collective dialogue

on how this evidence translates into their daily lives go beyond having an impact on the women themselves. Some mothers commented on how these insights were transferred to their conversations with their children at home. One reported example has impacted how their children resolve conflicts that may arise at school through nonviolence. On the other hand, mothers and teachers participating in the DSGs are leading the implementation of the dialogic model of conflict prevention and resolution in the school based on the evidence of the social impact they have learned about through the readings. This impact is related to social transformation, one of the principles of dialogic learning, and it is being collected in a new study that is now under development.

Regarding Research question 2: How have the DSGs influenced participants' knowledge of scientific research, their engagement with science and encouraged their participation, and their attitudes towards science? All of the participants, especially the mothers with lower education levels, had little or no contact with scientific activities. Some of the mothers had contact with scientific research through medical studies in which they participated as patients or because they had attended a conference held by an organisation of family members affected by a disease. There is abundant literature on community science activities to improve a community or its women on health-related issues (Hawkins et al., 2021; Lindsjö et al., 2021). However, there is a gap in community science actions on other topics beyond health promotion that involve women who are not generally engaged in science. This study contributes to overcoming this gap in knowledge about community science initiatives that are aimed at women who are not academics or scientists and that may have a benefit for them, their families, and communities beyond health promotion, specifically in promoting the prevention of violence and gender violence through education in their schools and communities.

Among the changes in attitude towards science that many women reported after participating in the DSGs, the most frequently mentioned was losing fear and overcoming reluctance to participate in scientific activities. Some of the participants noted that having to share what they read in discussions made them set reading goals. In addition, sharing the paragraphs that each participant highlighted and initiating an egalitarian dialogue about them contributed to losing the fear of reading scientific articles; they also reported learning from each other.

Regarding the participants' knowledge on scientific research, all women reported in the posttest FG that after participating in the DSGs, they acquired new scientific vocabulary, as has also been identified in previous studies with adults and children. (Díez-Palomar, 2020; Díez-Palomar et al., 2022). Some reported that reading about the methodologies through which the studies had obtained results contributed to their understanding of how science works. Acquiring scientific vocabulary, concepts, and knowledge about developing a study helped them understand the readings better as the DSG sessions progressed. In this way, the scientific article reading became an enjoyable space where they could discuss their chosen topics while learning to differentiate between opinions and scientific evidence.

The dialogic environment created in the DSGs led the participants to become more interested in science and the research behind it and to be more aware of its benefits for themselves, their children and their communities, as previous studies have also identified (Buslón et al., 2020; Díez-Palomar et al., 2022). The dialogues in the DSGs encouraged the participants to develop more critical and analytical thinking, becoming more conscious that both individual and community decisions need to be based on scientific evidence to improve their lives and those of their communities, an impact also reflected in two of these previous studies (Buslón et al., 2020; Díez-Palomar, 2020).

Some of the participants reported that participating in the DSG led them to engage with science, especially in gender and education. Some are beginning to incorporate into their daily lives access to sources to verify claims often heard in the media about violence and schooling through accessing online platforms aimed at identifying evidence and hoaxes in gender and education or through open-access scientific articles ('Adhyayana Scientific Evidence Platform Education', n.d.; 'Sappho Scientific Evidence Platform Gender', n.d.). All of the participants in the posttest FG agreed that if DSGs on citizen concern topics were implemented in more settings, society's interest and engagement with science would be increased. Some of the participants expressed interest in creating new DSGs, for example, in the neighbourhood secondary school. These findings add new insights to the few previous studies that have analysed citizens' motivations to engage in community science (Alender, 2016; Raddick et al., 2013; Reed et al., 2013) and citizen awareness of the benefits of science or community science (Brown et al., 2012).

Limitations

This qualitative case study was based on the perceptions of a small group of women; therefore, they cannot be generalised. However, this is also how knowledge advances in social research and all areas of knowledge. It is widely known that in social science research, when the variables being analysed are related to human behaviour, they are infinite and cannot be isolated. In this case, it is impossible to measure whether each variable influences the change in attitude towards science in each participant. What can be done and is done in this case study, as is done not only in social science research but also in the health sciences, is to validate the results of the same intervention to the extent that they have been the same in many other cases in very diverse settings. The results are similar when the intervention (DSGs) is replicated in other cases in diverse contexts. In this case study, it can be affirmed that after the implementation of DSGs, based on the seven principles of dialogic learning, the participants' interest and engagement in science increased, as has been the case in other interventions that were previously developed. More research on the replication of DSGs with diverse groups and in diverse settings is needed to gather further evidence on the potential of this community science action to engage citizens in science, especially targeting the least engaged groups.

Conclusion and implications for community science

This study provides new evidence on the replicability of the DSGs on violence and gender violence prevention through education in a group of women who previously were mostly not involved in science, promoting in them a more excellent knowledge of how scientific research works, as well as greater involvement in science and awareness about the importance of scientific evidence for the prevention of this social problem through education.

The contributions of this study and previous studies (Buslón et al., 2020; Díez-Palomar, 2020) highlight two crucial factors that need to be considered if DSGs are to be successfully replicated as a community science action. The first is that the topics of the scientific articles to be read should arise from the participants' interests. Second, the DSGs should be based on the dialogic principles that guarantee an egalitarian dialogue between the participants, promoting a collective creation of knowledge and meaning. It is not about one expert explaining to the others what is discussed in the article but about all the participants unravelling its content and making sense of it, as they can identify how this study's contributions can impact their lives, communities, and society. In this study, as in the previously referenced studies, these two elements have been identified as fundamental in generating motivation in the participants while at the same time helping to overcome the barriers that may exist when faced with a scientific text.

This study has identified that when the scientific activity proposed is based on the participants' interests and can directly benefit them and their community, citizens want to understand science and participate in it, as has been previously stated by other studies (Flecha, 2021).

Data availability

The datasets are not directly available online to ensure the necessary level of confidentiality and the legitimate utilisation of the data. Researchers interested in accessing any of the datasets are kindly requested to make a formal request by sending an email to Laura Ruiz-Eugenio and Ariadna Munte-Pascual. This request should be accompanied by the following documents: a formal letter containing the researcher's contact information, institutional affiliation, current position, the purpose of the research, details regarding the intended use of the data, and, if applicable, information about funding sources; an official letter from the researcher's affiliated university or research institution confirming their association; and a confidentiality agreement, duly signed by the researcher, indicating their commitment to maintaining the confidentiality of the data.

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Author contributions

The authors contributed equally to this work.

Competing interests

The authors declare no competing interests.

Ethical approval

All procedures performed in the study followed the ethical standards of the University's Ethics Committee of the University of Barcelona that approved the ALLINTERACT project. All data were anonymised and fulfilled Regulation (EU) 2016/6791 and the EU General Data Protection Regulation (GDPR).

Informed consent

Informed consent was obtained from all participants. In addition, the school management team gave explicit consent for the school's actual name to appear in the article.

Additional information

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