



DOI:10.22144/ctujoisd.2025.023

Enhancing the community resilience knowledge and engagements in sustainability initiatives of vulnerable children through citizen science-oriented non-formal education

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Article info.

Received 21 May 2024

Revised 14 Jun 2024

Accepted 30 Nov 2024

Keywords

Community resilience, sustainability, training evaluation, vulnerable children

ABSTRACT

The study examined the impacts of a Citizen Science Approach (CSA) on vulnerable children's community resilience knowledge and engagement in sustainability initiatives. Thirty (30) children in conflict with the law from the two Bahay Pag-asa Rehabilitation and Transformation centers underwent a series of participatory planning sessions and research training activities as part of non-formal education program with the central emphasis on biodiversity conservation, environmental protection, water security, health system resilience, natural resources management and food security, and waste management, which are sustainability areas of concerns in the City of Dasmariñas, Cavite. Data were collected using surveys, presentations, and focus-group discussions. On the other hand, content analysis, descriptive statistics, and Kirkpatrick's four levels of training evaluation were employed to analyze the data. Results indicated there was a significant improvement in the vulnerable children's community resilience knowledge and planned sustainability engagements as they actively participated in determining the causes of various community problems (contributory), analyzing and interpreting data (collaborative), and proposing action plans and working policies for possible research projects (co-creation). Furthermore, training evaluation revealed that vulnerable children were very satisfied with the learning resources, training environment, acquired learning experience, methods of training execution, and mastery of trainers.

1. INTRODUCTION

Empowering vulnerable children to participate in community engagements is an inclusive approach to development (Kellett, 2011; Bastable et al., 2022). As there are complex factors at play, adding up to

their vulnerabilities (Wangamati et al., 2018; Hapompwe et al., 2021), there is a dire need to uphold their basic rights (Berens & Nelson, 2015; Richmond, 2022; Herring, 2023;). Several studies reported that vulnerable children commonly have

limited or been deprived of opportunities to exercise their right to education, food and shelter, legal and health security, and development (Jopling & Vincent, 2015; Mascheroni et al., 2021; Shawar & Shiffman, 2023). This is primarily what makes them part of the marginalized and disadvantaged groups. Despite their unfortunate circumstances, they can be empowered to participate in building resilient and inclusive communities (Ellis & Dietz, 2017; Ashraf & Shah, 2019; Tarricone et al., 2021).

Vulnerable children are young individuals who have been left behind as an upshot of socio-economic inequalities (Bradbury-Jones et al., 2018; Westwell-Roper et al., 2021). They have been suffering from the consequences of these growing inequalities (Fanjul, 2014; Von Grebmer et al., 2017), which adversely affect their social and economic potential (Engle et al., 2011). Without adequate and inclusive support for their growth and development, they might be forced, abused, and exploited, or resort to committing unethical and illegal practices (Masonbrink & Hurley, 2020; Geovani et al., 2021), which only exacerbates community problems. Others might experience discrimination, deprivation, and stress due to their disadvantaged situations (Mascheroni et al., 2022). It has been argued by organizations advocating for children's rights and protection that societal issues involving children have stemmed from a lack of or failure to implement inclusive policies and programs (Ferguson, 2021).

Overcoming child vulnerability has been underscored in the Framework for Policy Action on Inclusive Growth launched by the Organization for Economic Cooperation and Development (OECD) in 2018. One of the key policy recommendations stipulated therein is investing in vulnerable children to build a more resilient and inclusive society. By utilizing cross-cutting strategies focusing on improving their well-being, it is strongly believed that vulnerable children can develop their abilities and capacities and strengthen their social and emotional skills (Lacunza, 2014; Dolan & Caires, 2020). Enabling vulnerable children to possess protective traits and skills, which can be used to overcome risks, can transform them into productive and responsible members of society. One way of strengthening the protective factors for vulnerable children is by involving them in community-based programs and activities. This empowerment strategy targets positively influencing their attitude, perceptions, and behaviors.

To reduce the likelihood of vulnerable children being exploited, abused, and neglected, they must be involved in community-based activities to raise their awareness of certain issues related to health, environmental protection, and education, among others (Milteer et al., 2012; Hart, 2013). Additionally, connecting them to community-based activities allows them to participate in addressing various social, economic, and environmental issues in the communities.

However, scientific evidence on vulnerable children involved in sustainability initiatives was still sparse due to (1) a dearth of primary research on the participation of vulnerable children in community engagements and (2) limited data obtained describing their community resilience knowledge. These identified gaps can be addressed using citizen science. Citizen science (CS) is a form of community-based participatory research that mobilizes all stakeholders in the research process to achieve transformational social change (King et al., 2021). This approach can be used to understand the knowledge and experiences of vulnerable children and stimulate their motivation to participate in CS projects and contribute to scientific discoveries.

Furthermore, as this research approach is often facilitated using digital technology, socially disadvantaged groups, such as vulnerable children, are typically excluded from CSA projects. To address these identified gaps, this study generally aimed to explore community resilience knowledge and community engagement in sustainability initiatives of vulnerable children through a citizen science approach in non-formal education.

Specifically, the study sought to achieve the following research objectives: (1) determine the vulnerable children's reactions to the CSA-oriented training session component; (2) describe the learning experiences of the vulnerable children on the CSA-oriented training sessions grounded in four models of CSA; (3) examine the behavioral changes occurred after the CSA-oriented training sessions; and (4) analyze the effects of the CSA-oriented training sessions on the vulnerable children's commitment to community resilience and sustainability.

2. MATERIALS AND METHOD

2.1. Research design

The researchers employed both quantitative and qualitative research designs to achieve the research objectives. These research designs were integrated

into Kirkpatrick’s four levels of training evaluation. As shown in Table 1, Kirkpatrick’s model is divided into four levels namely, (1) Reaction, which makes use of after-training survey that determines how well the planning sessions were conducted; (2) Learning which examines if the children have acquired the intended outcomes in knowledge, attitudes, and skills; (3) Behavior which analyzes how the learnings have been incorporated in the lives of the children; and (4) Results which lay down the commitment of the children to actualize the plans and its effects on community resilience and sustainability efforts (Kirkpatrick & Kirkpatrick, 2016).

With the given levels, quantitative research was used to describe the reactions of the participants to the planning session and research training activities using the survey instrument with a 5-point Likert Scale, where five (5) means very satisfied while one (1) indicates high dissatisfaction. On the other hand, a qualitative research design was utilized to achieve the remaining three research objectives.

2.2. Participants of the study

Thirty (30) children in conflict with the law residing at the two Bahay Pag-asa Rehabilitation and Transformation centers in the City of Dasmariñas were the participants of the study. All of them were male and ranged from fifteen (15) to twenty (20) years old. One center is under the supervision of the City Social Welfare and Development Office (CSWD), while the other one is managed by the De La Salle University-Dasmariñas (DLSU-D).

2.3. Data collection procedure

Before the inception of the data collection process, the researchers carefully complied with the ethical guidelines and data privacy policies of the two institutions, the CSWD and the Kolehiyo ng Lungsod ng Dasmariñas, the researchers’ home institution. The researchers also carefully took into consideration the mandated policies of the Juvenile Justice and Welfare Council, an agency mandated to supervise the implementation of policies that protect the rights of children in conflict with the law in the Philippines.

In the first part of the process, a short orientation was held to explain to the children the purpose, benefits, and even potential bias and disadvantages of their participation in the conduct of the study. To determine the background knowledge of and previous engagement in community resilience of the children, an initial semi-structured interview was

conducted. The information served as baseline information for the conduct of the planning sessions. Results were verified by the personnel from two centers.

Since vulnerable children were restricted from going outside the premises of the centers, digital learning tools such as videos captured in actual context, photos taken from the local environment, and recorded interview sessions were utilized to present to them the primary data that will be subjected to analysis during the planning sessions and research training activities. Those activities were facilitated by the researchers, scientists, and policymakers who teach the children about the relevance of active participation in community resilience and sustainability initiatives (*contributory*), the process of analyzing and interpreting data (*collaborative*), and stages in creating action plans (*co-creation*). While the full demonstration of acquired knowledge can be actualized through leading a community project (*citizen-led*), such a practice could not be done since the children were deprived of the liberty to interact with people outside the rehabilitation and transformation centers. All these processes were the four models of Citizen or Community Science.

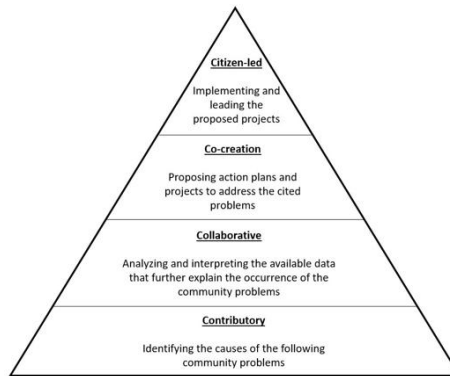


Figure 1. Four models of citizen science

(Source: Adapted from Den Broeder et al. (2018) and English et al. (2018))

After the two months of training sessions, children’s reactions to the conducted activities approached in CSA were described using a survey questionnaire. This instrument consists of indicators that measure these five parameters: learning resources used, training environment, acquired learning experience, methods of training execution, and mastery of trainers. Responses to the survey were analyzed using descriptive statistics.

Supporting the results of the participants’ reaction, the researchers asked the participants to assess their learning experiences from the CSA-oriented training session using focus-group discussions. The results were supplemented by the written activities of the children. Thematic analysis and document review were employed to examine the qualitative results.

Children’s changes in mindset, behavior, knowledge, practice, and skills were keenly observed to highlight if the outcomes of the training sessions lean towards the positive side. These changes also recorded the consistency of applying the knowledge obtained from the activities about community resilience and sustainability. Since the researchers could not precisely take note of the behavioral changes that occurred among children

through frequent visits, observation notes taken by the personnel during the day-to-day activities in the centers were reported to the researchers through key-informant interviews. Content analysis was utilized to examine the results. The level of the training evaluation model is the result. This was done to determine how impactful the planning sessions and research training activities were on the children’s commitment to public service, transformative change, and civic responsibility. It presented the individual pledge to address community-based problems through actively collaborating with researchers, policymakers, educators, etc., in doing scientific research or formulating research-backed public policies. Like the previous objective, content analysis was also employed to examine the valuable ideas derived from the responses.

Table 1. Kirkpatrick’s four levels of training evaluation

Four levels of evaluation	Research objectives	Data collection method	Data analysis tool
Level 1 (Reaction)	Determining vulnerable children’s reactions on the CSA-oriented training session component	Survey questionnaire	Descriptive statistics
Level 2 (Learning)	Describing the learning experiences of the vulnerable children on the CSA-oriented training sessions grounded in four models of CSA.	Focus-group discussion Daily learning Journal	Thematic analysis Document review
Level 3 (Behavioral changes)	Examining the behavioral changes occurred after the CSA-oriented training sessions	observation Key-informant interview	Content analysis
Level 4 (Results)	Analyzing the effects of the CSA-oriented training sessions on the vulnerable children’s commitment to community resilience and sustainability	Semi- structured interviews	Content analysis

3. RESULTS AND DISCUSSION

3.1. Vulnerable children’s reactions to the CSA-oriented training session components

Table 2 presents the vulnerable children’s reactions to the CSA-oriented learning sessions during the training activities in terms of the following parameters: earning resources used, training environment, acquired learning experience, methods of training execution, and mastery of trainers. Generally, participants were very satisfied with the series of training sessions that dealt with community resilience and sustainability issues. While they had little to no background knowledge about the topics being discussed, all participants showed a high appreciation for the way and how the target objectives were achieved and how the CSA truly empowered them as individuals who can still contribute to the wider community despite the

restrictions and limited mobility indicated in the general laws. This statement was relevant to what Cooper et al. (2021) stated, describing CSA as empowering and inclusive since it allows individuals who are not professionals to be significant contributors to scientific knowledge.

In terms of learning resources, the participants were very satisfied with the digital learning materials used to carry out the instruction. The utilization of the videos and pictures allowed children to have an overview of the problems besetting the community of Dasmariñas through immersive and authentic presentations. The flexibility and versatility of these learning tools have equipped them with adequate knowledge and understanding of various complicated issues in the environment and the current projects initiated by the government to mitigate these issues. More importantly, despite restricted mobility, children were able to broaden

their perspective on the relevance of collaborative actions to gradually attain sustainability by simulating a real-world context. These results can be

related to the study by McKnight (2016), which highlights the effectiveness of utilizing digital technologies in instruction.

Table 2. Results on the children’s reactions on the CSA-oriented training sessions

Learning resources	Weighted mean	Standard deviation	Adjectival interpretation
Audiovisual aids were utilized to enhance the learning experience.	4.48	0.78	Very satisfied
Videos and pictures improved comprehension of the lesson.	4.67	0.66	Very satisfied
Adequate materials were supplied to meet learning goals.	4.50	0.86	Very satisfied
Activities were supplied with adequate materials.	4.63	0.67	Very satisfied
There were available learning materials throughout the lecture.	4.48	0.87	Very satisfied
Weighted mean	4.55		Very satisfied
Training environment			
The room was clean.	4.93	0.37	Very satisfied
The room was well-ventilated.	4.77	0.43	Very satisfied
The room was free from distraction.	4.77	0.50	Very satisfied
The room was spacious for groupings and activities.	4.77	0.50	Very satisfied
The room was safe and security measures were provided.	4.77	0.43	Very satisfied
Weighted mean	4.80		Very satisfied
Learning Experiences			
Lesson presented community issues and challenges with adequate details and research-backed information.	4.63	0.61	Very satisfied
Lesson promoted civic engagement by proposing strategies and policies to address local issues and challenges in the community.	4.60	0.50	Very satisfied
Lesson incorporated collaborative activities.	4.77	0.50	Very satisfied
Lesson promoted critical thinking and problem-solving.	4.73	0.45	Very satisfied
Lesson met my expectations.	4.63	0.56	Very satisfied
Weighted mean	4.67		Very satisfied
Training/Lesson Execution			
Lesson was properly presented and delivered.	4.73	0.52	Very satisfied
Participation and interaction were encouraged during the lesson.	4.63	0.67	Very satisfied
Lesson was aligned with the objectives.	4.80	0.48	Very satisfied
Lesson had appropriate pacing.	4.63	0.72	Very satisfied
The time allotted for the lecture was sufficient.	4.73	0.45	Very satisfied
Weighted Mean	4.71		Very satisfied
Mastery of the Lecturer/Trainer			
The lecturer/trainer demonstrated mastery of the subject matter.	4.83	0.38	Very satisfied
The lecturer/trainer explained the lesson well.	4.70	0.53	Very satisfied
The lecturer/trainer was well-prepared.	4.80	0.48	Very satisfied
The lecturer/trainer was able to answer all my questions.	4.77	0.57	Very satisfied
Presentation of the lesson was engaging.	4.87	0.35	Very satisfied
Weighted Mean	4.79		Very satisfied

**Legend: (5:00-4:20 (Very satisfied); 4.19-3.40 (Satisfied); 3.39-2.60 (Moderately satisfied); 2.59-1.80 (Slightly satisfied); 1.79-1.00 (Dissatisfied)*

Tantamount to the learning resources is the training environment, which also received a high satisfaction rating from the participants. The stimulating learning environment made them stay focused on the training sessions, as it was free from any distractions. Children were able to regulate their emotional and behavioral aspects as the learning

space was perceived as safe and secure. Furthermore, children's engagement and enjoyment increased due to the spacious learning environment. They could move around and remain in comfortable corners, especially when critically thinking about primary data analysis, proposed interventions for identified community problems, and various

research designs and their applications. Baepler et al. (2014) stated that the physical environment positively impacts the learning process.

Another noteworthy result was observed in the learning experiences, which received a high satisfaction rate as well. Children's training on the local community problems, planning methods and tools, research designs, basic data analysis, and project proposals provided meaningful learning experiences to them. The experiential approaches highlighting collaboration, communication, critical thinking, and problem-solving strengthened the children's shared responsibility to promote community welfare. Children's inclusion into the policymaking process and community planning made them feel valued and appreciated despite the fact that they had been sanctioned for disobeying the humanitarian laws. Moreover, the activities allowed them to rethink their ways and reassess themselves, leading to a more positive behavioral transformation. Through the proposed plans, children were able to optimize their life perspectives towards a more productive and worthy living. In relation, these findings re-echoed the call for the need to uphold the rights of vulnerable children to equitable education, healthcare, and other social services (Herring, 2023).

Aside from valuable skills and civic responsibility, vulnerable children also learned the relevance of mutual respect and compassion when dealing with others. Since they comprehensively understood the striking ideas shared during the sessions, these children were encouraged to upskill and reskill themselves as a strategic response to the frequent changes. All of these were the result of executing the lessons well. In addition, sustained interaction and increased engagement were also noticed, as the children could easily follow the objectives to be attained and the presentation of lessons. As surfaced in the study by Buehl (2023), making the delivery of the lessons engaging and interactive is one of the factors that reinforces learning.

Lastly, the evaluation of the trainers' mastery of the topics and instructional techniques received a high satisfaction rating from the participants. Trainers' professional growth, preparation, and expertise were remarkably seen in the way they select strategies in delivering instruction, explaining concepts, motivating learners, and calling for actions as an application of learning. The assistance provided by the policy-makers and researchers to the children when understanding complicated

concepts and doing critical learning tasks such as data analysis, policy proposals, and problem analysis paved the way for a more synergistic relationship and meaningful collaboration towards attaining a resilient and sustainable community. Similar results were found in the study by Kalinoski et al. (2013), indicating how the training session outcomes are highly influenced by the trainers' overall skills in facilitating the lesson and in helping their trainees integrate learned concepts into real-life situations.

3.2. Describing the learning experiences of the vulnerable children in the CSA-oriented training sessions grounded in four models of CSA

The two-month planning sessions and research training activities already serve as the community immersion of the participants. While these may not be as actual as originally designed, the training activities were still meaningful learning experiences as the digital tools used to bridge the gap between the theoretical understanding and practical learning applications of community initiatives. Similarly, King et al. (2016) showed a favorable stance on the use of digital technologies when facilitating CSA along the process of educating children.

Also, the series of activities facilitated by the researchers, scientists, and policymakers obliged children to uphold the principles of CSA when examining the causes of community problems (**contributory**), organizing, sorting, and analyzing the available data about those problems (**collaborative**), designing policies, programs, and projects which serve as interventions (**co-creation**), and implementing these interventions and evaluate its effectiveness (**citizen-led**). In effect, these four levels of CSA helped children broaden their understanding of their individual role in the collective transformative changes in the community. This affirms the statement indicated in the study by Kobori et al. (2016), which entails that involving children in CS projects provides them with the opportunity to advance their knowledge on certain issues and contribute to scientific discoveries.

With these in mind, using thematic analysis and document review, the learning experiences revealed through focus-group discussions and personal journals of the participants were meticulously described and were presented in these five (5) themes:

3.2.1. Sustainable policy is the building block of community resilience

This theme encapsulates the idea that crafting policies that fundamentally come from the grassroots would make the proposed solutions more inclusive and empowering. Sustainable policies, as revealed in the interviews, are created with attainable targets, and formed through in-depth consultations with all sectors. These policies must also be future-proofed and context-specific to provide simple but appropriate solutions in addressing community problems that concern sustainability areas of the local government of Dasmariñas, such as biodiversity conservation, environmental protection, water security, health system resilience, natural resources management and food security, and waste management. In this way, the community could hold its ground against constraints that limit continuous improvement. In developing community resilience, Levit (2017) emphasized the significance of a bottom-up approach to policymaking to ensure development practices and outcomes are sustainable.

Furthermore, the participants shared that the ever-changing nature of the world mandates the community to strengthen its proactive and reactive policies to remain stable and adaptive within its proactive and reactive policies to remain stable and adaptive to external pressures, crises, and disturbances grounded in social, political, economic, and environmental contexts. For instance, in the City of Dasmariñas, low water supply is one of the problems encountered in some parts of the city. The insufficient water supply exacerbates other problems related to health, sanitation, and nutrition. In response to these concerns, vulnerable children argued that conservation policy regulation and monitoring systems regarding water utilization in residential areas, business establishments, educational institutions, companies, and government-built infrastructure must be strengthened to optimize the status of water supply. As explained by Khan et al. (2018) in their study, developing responsive and proactive mechanisms promotes resilience, which enables the community to cope with social and environmental challenges.

3.2.2. Community resilience is a product of micro efforts

This theme argues that attaining sustainability does not require people to take an instant big leap. As emphasized in the children's personal learning

journal, even a micro effort initiated by an individual could drive a possible change in the community. Children's proposed policies were mostly simple acts and required few physical, financial, and mental resources. They also added that no matter how small the efforts that any individual puts into, when collated, it could still generate a powerful move towards positive change. Moreover, the participants viewed resilience as an effect of strategic direction, early preparation, and collective actions toward strengthening the community's response to risks and vulnerabilities. This was supported by Adger (2010), stating that making a difference for the community starts from collective efforts among individuals who demonstrate communal unity.

As revealed in the proposed projects, the participants suggested that the education sector may find an opportunity to craft localized storybooks that deal with various community problems and sustainable practices such as water conservation, non-utilization of polluting materials, responsible consumption, and environmental protection. Through this small initiative, children, even at an early age, would be able to understand the public life in the community. They may also nurture their potential to become responsible citizens who make sense of their lives through civic engagement and public service. In the study by Chang et al. (2013), it was also stressed that learning materials should be contextualized based on the local settings so that children can easily relate to concepts pertaining to various community issues.

3.2.3. Innovation is a prerequisite to thrive in the present times

This theme emphasizes that seeking innovation is crucial for the development of ideas. It allows individuals to use previously learned knowledge and acquired skills to set new conditions of learning and to produce new forms of ideas. While innovation fuels engagement and community transformation, it must be handled and implemented properly to avoid possible erosion of culture, relationships, the natural environment, and humanity in general. In these regards, participants claimed that innovation is what the community needs to do. With the problems that are increasingly becoming serious, there is a dire need to look for new techniques and potential ideas that could drive the community towards sustainable living. Supporting this, Legner et al. (2017) also explained in their study how innovations transform communities and make lives better.

In the world of artificial intelligence, various innovative proposals have been seen in place waiting to be funded by public or private sectors to bring forth community transformation. Given these, participants highlighted in the interview that the local government should invest in innovation to recalibrate the practices, optimize operations, and improve public service to reduce problems in waste management, water quality and scarcity, and health sanitation. However, they also cited in the problem tree diagram that the most common cause of the community problems is the lack of discipline, as some people failed to acknowledge the importance of conservation, protection, and responsible utilization of resources while seeking innovation. In fact, unregulated and irresponsible innovation may aggravate the present problems and lead to the loss of resources and public distrust of development, which would disrupt the initiative to achieve community resilience.

3.2.4. Community resilience is a summation of constant personal growth.

This theme entails the role of every individual in the realization of sustainable living in a resilient community. This existential responsibility recognizes the relevance of personal growth for the identity-formation of the community. Resilience is a collective strategic response to changes, whether positive or negative, that may affect the public welfare. Building a resilient and sustainable community requires numerous intellectually mature and socially responsible individuals who continuously seek meaningful and progressive community transformation.

Most of the participants wrote in their journals that they became highly interested and very satisfied with the series of planning sessions and research training activities provided by the researchers. Not only did they learn technical knowledge, but they also instigated their passion for helping the community. The videos that showed the different community problems and the data that were analyzed for policy proposals broadened their understanding of the purpose of life. These activities may serve as a redirection for them towards promoting a common good. As emphasized in the interview, participants mentioned that they have grown intellectually by leaps and bounds as they had been exposed to planning tools, addressing community issues, and proposing projects related to the priority development areas of the city: biodiversity conservation, environmental

protection, water security, health system resilience, natural resources management and food security, and waste management. These learning outcomes support the effectiveness of the community-based training program in improving the knowledge of vulnerable children regarding relevant issues in the community (Baldrige et al., 2017).

3.2.5. Resilience means empowering the vulnerable sectors

Vulnerable sectors' involvement in the policy-making process and in crafting research-oriented solutions for community welfare would make them feel valued and heard. Such participation would increase the sector's capacity to untie themselves from the peripheral chain, making them eligible partners of the government in securing a sustainable future and not just receivers of the spillover effects of the decision made by negative externalities. In addition, the sectors' participation in the decision-making process is a good manifestation of inclusive community governance and safe learning environment from them as it would reduce the sector's exposure to high-risk activities that may further exacerbate their marginalized status. These results were also reflected in the study by Walsh et al. (2015), highlighting the value of empowering the vulnerable sectors to strengthen the protective factors that lead to their resilience.

During the interviews, in the city of Dasmariñas at least, participants collectively shared that all sectors are given the absolute right to form an association, organization, and any group that would holistically represent the causes, struggles, opportunities, and aspirations in the policymaking body. However, while there were already organizations that represented persons with disabilities (PWDS), poor people, minority groups, the elderly, women, and children, it was argued that no one ever represents the children in conflict with the law and even those persons who are deprived of the liberty in the policy-making process. Therefore, with the training sessions conducted, the participants realized that they could still make worthy actions and give contributions to the community despite being confined to the walls of the centers as they proposed plans, programs, and projects to mobilize community resilience. In consonance, Perry-Hazan (2016) asserts that children must also be included in policymaking to empower them to be productive and responsible citizens as they transition to adulthood.

3.3. Examining the behavioral changes occurred after the CSA-oriented training sessions

Changes in behavior, mindset, perspective, values, beliefs, and skills of the vulnerable were recorded by the researchers using the observation notes and conducting key-informant interviews with the office directors or key personnel from the two transformational and rehabilitation centers.

Results indicated that working with researchers, policymakers, and scientists during the training period made the vulnerable children more mature when analyzing basic and complex ideas and when giving meaning to life. Participants also became more interested in deepening their engagements in the community as they learned the process of community-based planning, basic analysis (including sorting, organizing, and classifying the data), and graphic organizers to enhance logical reasoning. The enhanced public understanding of the community problems anchored in CSA has created long-lasting positive impacts on the futuristic views of the children, as some already envisioned themselves as agents of change who bring forth community welfare.

It was also observed that some children manifested high interest in community development, research, and policy-making during the training sessions, as they actively participated in analyzing the causes and results of the different community problems in the city of Dasmariñas. Using the available data and the videos presented, these children exhibited keen observation and thorough examination of the details defining them as true novice researchers. Participants' exposure to planning methods and simple data analysis has advanced their response to the problems encountered in the community. Some of them conveyed their desire to lead community-based projects after they had been released from the custody of the two centers. In relation, the above findings reflected in the study by Ashraf and Shah (2019), in which they found that the training sessions promoting sustainable practices and care toward nature positively influenced the perceptions, attitudes, and behaviors of vulnerable children, thus stimulating their interest to protect the environment.

Among others, the most important change that has been observed is accepting the challenge of becoming a responsible and competent citizen who actively participates in addressing community problems, promotes effective strategies to achieve social cohesion, seeks innovation and continuous

improvements, and, more importantly, contributes to community transformation guided by the principles of resilience and sustainability. As Lúcio and I'anson (2015) elucidated in their study, community engagements enable vulnerable children to develop good citizenship values, such as respect for the law and patriotism.

3.4. Analyzing the effects of the CSA-oriented training sessions on vulnerable children's commitment to community resilience and sustainability

While the general effects of CSA-oriented training sessions were impossible to measure in an instant, the participants' pledges of commitment to community resilience and sustainability engagements, shared through semi-structured interviews, were carefully collated and analyzed to surface the long-lasting effects of the CSA-oriented training sessions.

Results revealed that the conduct of training sessions with assistance from experts has strengthened the participants' commitment to self-growth and leadership skills enhancement. Experiential learning, scaffolding, digital learning, and other invaluable approaches have fostered participants' self-growth. Self-growth means, as defined by them, understanding that one is not solely created for himself or herself; he or she plays a critical role in helping the community achieve its empowerment. One is obliged to keep himself or herself well-informed about the community, including its structures, dynamics, and attributes, to engage in volunteering activities that promote worthy socio-civic causes, and to support actions that articulate self-initiated improvement as a contributor to community empowerment. These would make children no longer vulnerable as they gradually step into becoming transformative community leaders. In bringing forth positive change to the community, Leke et al. (2016) underlined that intrinsic values such as self-growth can increase the community contributions of the people, thus making it an important attribute to development.

Strengthening citizenship competence was another commitment embedded in the pledge statements of the participants. This citizenship competence goes beyond merely participating in socio-civic activities but leading sustainable projects or programs that aim to level up that dynamism at the community level. Vulnerable children, after the rehabilitation period, promised to advocate for a greater good by

involving in some youth-led extension projects, helping maintain peace and order in their respective barangays, and attending training to further equip themselves with knowledge and skills related to sustainability. Full and unrestricted participation in the socio-civic sphere of life would make them responsible citizens. Developing citizenship competencies among children has been a priority of different international organizations as part of their efforts to achieve SDGs (Nygren et al., 2020).

Lastly, it was emphasized in the interviews that community resilience and sustainability engagements are taken as a commitment to lifelong learning. The motivation of the vulnerable children to always take advantage of the learning opportunities has been instigated after realizing that true knowledge is not only obtained in a formal classroom but also in a non-formal scenario. The apprenticeship approach employed during CSA-oriented training allowed children to be supervised by the researchers and policymakers in utilizing appropriate planning tools, analyzing data, acting project proposals, and leading community-based projects. Not only did the children learn these topics, but they also acquired life lessons, new perspectives, and stories of hope, which, in the long run, would drive them to make better decisions in life. These findings can be associated with what Hsu et al. (2023) emphasized in their study, which is that using CSA in non-formal learning allows learners to engage in scientific investigations and interact with their environment actively.

4. CONCLUSION

The participation of vulnerable children in the CSA-oriented training sessions is an empowering, inclusive, and sustainable initiative developed and designed to strengthen community resilience. Using CSA, children in conflict with the law, who are vulnerable to risk factors rooted in their socio-economic environment, effectively explored sustainability concepts, practices, and policies along with researchers during the training sessions. As such, CSA promotes inclusive opportunities for vulnerable children as they worked with research experts toward achieving transformational changes in the community. Moreover, the CSA-oriented training sessions have influenced the perceptions, attitudes, and behaviors of the vulnerable group, thus motivating them to create a significant change for the community. This presents a positive perspective on using CSA as a tool for empowering

vulnerable groups to achieve community resilience and sustainability.

Given these, the CSA was found very effective in collecting feasible solutions to the issues besetting the community from those groups who have less appreciation of science. The positive rapport of the children with the sessions has strengthened the significance of CSA in increasing the public understanding of science among vulnerable sectors, as this provides a supportive learning environment grounded in the scaffolding learning strategy.

In addition, the results of the study confirmed that children, even at a young age, can become active contributors to the sustainability efforts of the government. They may also forward valuable ideas that can partly or permanently solve the long-overdue community-based problems. Moreover, despite some being considered as juvenile delinquents, these children can still commit themselves to changing their destructive behavior to being mobilizers of development in their respective communities through the use of CSA.

5. RECOMMENDATIONS

Policymakers, researchers, and local officials may utilize CSA to increase the engagement of vulnerable sectors in optimizing processes and revisiting social policies to achieve community resilience. They are also encouraged to coordinate with various organizations and associations formed to advance the rights of vulnerable sectors to craft a sectoral empowerment roadmap that summarizes the collective aspirations and struggles, recommended programs and projects, and suggested strategies and pathways to a resilient and sustainable community.

It is also suggested that short learning courses that deal with priority areas of the City of Dasmariñas, such as biodiversity conservation, environmental protection, water security, health system resilience, natural resources management and food security, waste management, and other community-based problems may be designed to teach other vulnerable sectors about these aspects of community resilience and sustainable living. The inclusion of community immersion in different government offices that supervise the said priority areas in the post-release program of the transformational and rehabilitation centers may serve as redirection assistance given to the vulnerable children towards nurturing positive self-growth.

Furthermore, it is also recommended that scientific communities and researchers develop and provide non-formal training initiatives in data analysis, data visualization, research designs, collection tools, and analysis, and other essential initiatives with vulnerable children to equip them with skills and knowledge to become research assistants. This

would make them realize the significant contributions they could make in promoting public welfare. It would also give them a chance to secure a worthy-living life through understanding the nature of the community and helping the government achieve sustainable development for the community.

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