

CITIZEN SCIENCE ENGAGEMENT: INSIGHTS FROM THE 'BRIDGING WORLDS' INITIATIVE ON LIBRARIES AS CONNECTORS

Nurfarawahidah B.^{1 2 *}
Mohd Faizal Hamzah³
Cik Ramlah Che Jaafar⁴
Ranita Hisham Shunmugam²
Amirul Firdaus Zilah⁵

¹ Al-Bukhari Library, Universiti Teknologi MARA Pahang, Jengka Campus, Pahang.
(Email: farawahidah@uitm.edu.my)

² Department of Library and Information Science, Faculty of Arts and Social Science, Universiti Malaya;
(Email: farawahidah@uitm.edu.my; ranita@um.edu.my)

³ Universiti Malaya;
(Email: faizal586@um.edu.my)

⁴ College of Computing, Informatics & Mathematics, Universiti Teknologi MARA (UiTM);
(Email: cramlah@usm.my)

⁵ Universiti Malaysia Kelantan;
(Email: amirul@umk.edu.my)

* Correspondence: farawahidah@uitm.edu.my

Article history

Received date : 15-8-2024
Revised date : 16-8-2024
Accepted date : 7-9-2024
Published date : 15-10-2024

To cite this document:

Nurfarawahidah B., Hamzah, M. F., Che Jaafar, C. R., W. Shunmugam, R. H., & Zilah, A. F. (2024). Citizen science engagement: Insights from the 'Bridging Worlds' initiative on libraries as connectors. *Journal of Islamic, Social, Economics and Development (JISED)*, 9 (66), 919 – 929.

Abstract: *Recently, citizen science has been an active way to mobilize the public in conducting scientific research to put more focus on community groups by improving their involvement in the research process and level of scientific literacy. Libraries and non-governmental organizations (NGOs) have served as the main users and supporters of such events. The assignment reviews the evaluation of the "Bridging Worlds: Libraries as Connectors in Citizen Science" event conducted by the Librarians Association of Malaysia in cooperation with academic libraries to promote citizen science. The purpose of the program was to educate the target audience on the notion of citizen science and evaluate whether the participants would grasp the extent of the roles that PPM and libraries play in the identified context. The designated research used a quantitative design in which 188 participants were asked to take a test before and after the program. The latter showed an increase in learners' awareness of the concept of citizen science and willingness to engage actively in the identified type of activity. This article shows that the role of the NGOs, for example, PPM, and academic libraries in the process of promoting the citizen science movement and involving the public was seen as critically significant. The example of collaboration shows that cooperation between NGOs, libraries, and local communities can support the evolution of long-term citizen science. The featured activity plays an important role. It might also be better if future programs focus on revealing the real results of the citizen science experience. Moreover, the study proposes to combine a monitoring and feedback system, which would allow monitoring the dynamics of the*

participants' success. Thus, the findings present important lessons and recommendations for the formulation and adaptation of citizen science policies and practices in Malaysia. It was mainly identified that cooperation between NGOs, libraries, and communities should continue to be fostered.

Keywords: *Library Science, Citizen Science, Public Engagement, Science Literacy, Librarians Association of Malaysia*

Introduction

Citizen science, which is one of the main aspects of open science, was assessed by the European Commission (2020) alongside other crucial elements like FAIR data, next-generation metrics, research integrity, incentives and rewards, education and skills, the European Open Science Cloud, and the future of scholarly communication. Based on UNESCO (2021), "open science" contributes positively to sustainable development since it embraces cultural diversity and ways of knowledge. It enhances the free flow of information within local populations, indigenous peoples, and various knowledge holders, which can address current challenges and inspire innovative solutions.

Open Science has an impact on Citizen Science by expanding its visibility, promoting collaboration, data management and usage, and having an impact on regulation and study (Ignat & Ayris, 2021; Tzovaras, 2024). Here, open science aims at making research outputs more accessible to practitioners, while citizen science engages non-professionals in research practice and generalises access to research platforms across disciplines and settings (Robinson et al., 2018; Haklay et al., 2021). NGOs and libraries have been at the forefront of this process through the promotion of participation within communities and reinforcing scientific literacy along with the creation of a culture to encourage collaboration in research (Harrington, 2019; Mumelas & Martek, 2024).

With the growth of the citizen science movement all over the world, more and more NGOs like the Librarians Association of Malaysia (PPM) and university libraries play a crucial role in promoting and developing more citizen science projects. Particularly, PPM has spearheaded efforts towards community involvement and knowledge sharing as the potential of citizen science.

This paper provides insights from the 'Bridging Worlds: Libraries as Connectors in Citizen Science' initiative, organized by PPM's Committee on Regional and International Relations (JKPSA) in collaboration with the U.S. Embassy in Kuala Lumpur, various libraries, and universities across Malaysia. The program, which took place from February 19th to 28th, 2024, was intended to connect libraries and citizen science, increase engagement, and include citizen science in community plans. The ten-day program included workshops, practical sessions using such instruments as iNaturalist, and discussions concerning the issues of diversity and climate change, as well as the keynote speech and the main tutor's speech by Vivienne Byrd, who also illustrated the main concept of the program, i.e., the idea of making the community of library professionals and the community of citizen scientists strongest.

Reliable intermediaries, including libraries and non-governmental organizations, are critical for citizen science efforts, helping to designate the ways in which the public can become involved, increasing scientific literacy among citizens, and facilitating research collaboration (Ramoniené, 2023; Mumelas & Martek, 2024). These organizations take advantage of their

local communities, educational resources, and collaboration channels to improve participation opportunities, empowerment, and ethical considerations of the initiatives (Azhima et al., 2022). By providing the intermediary role, libraries and NGOs make the dual-objective initiatives more feasible, assisting the contact between the public and the research personnel and more efficiently translating the concepts within the range of citizens, and ensuring long-term sustainability (Kowalska-Chrzanowska, 2024).

This paper aims to analyze participants' knowledge of citizen science. It seeks to explore the perception, level of awareness, and involvement of students at the University of Malaya in citizen science. The analysis of the results of the study gives an opportunity to confirm new insights into the strategic mission of NGOs and such organizations as the Malaysian Libraries Association and its critical cooperation with academic libraries in promotion and citizen science implementation in local communities.

Method & Material

Study Design and Data Collection

The 'Bridging Worlds: Libraries as Connectors in Citizen Science' program was developed as an intervention-based study conducted from February 19-28, 2024. The intervention involved participants in diverse activities, which included talks, practical sessions as well as discussion forums. The program occurred across several Malaysian universities, including Universiti Malaya, UiTM Pahang, IIUM Kuantan, Universiti Malaysia Kelantan, and Pustaka Negeri Sarawak. The program's main objective was to boost participants' understanding of citizen science, raise awareness of the role of the Librarians Association of Malaysia (PPM) and academic libraries in supporting these initiatives, and establish a network of advocates for citizen science within the academic community.

For the evaluation of the program, a structured questionnaire aimed at collecting quantitative data was developed. For the sample, the purposive sampling method was utilized to select the people who would most likely benefit from the program. The questionnaire was reviewed by the expert panel, who is there subject specialists, which evaluated three key areas: (i) Baseline Knowledge of Citizen Science to measure participants' initial understanding of citizen science; (ii) Perceptions of the Role of PPM and Academic Libraries, to evaluate participants' views on the involvement of PPM and academic libraries in citizen science initiatives; and (iii) Engagement and Advocacy, to gauge participants' likelihood of engaging in or advocating for citizen science initiatives following the program.

The survey was administered online at two different points: prior to the start of the program (pre-program) and immediately after the program concluded (post-program). A total of 188 participants completed both the pre- and post-program surveys, providing a dataset that allowed for the measurement of changes in knowledge, perceptions, and attitudes.

Data Analysis Techniques

Data was analyzed using SPSS version 29. Quantitative data were analyzed using descriptive statistics to summarize participants' responses and inferential analysis, including paired t-tests to identify statistically significant changes in knowledge and attitudes. The analysis focused on key variables, such as participants' knowledge of citizen science, their perceptions of PPM and academic libraries, and their engagement with citizen science initiatives. The results were

interpreted to determine the program's impact on participants' understanding and advocacy of citizen science.

Findings

Participant Demographics

The survey conducted among participants of the citizen science program reveals a diverse demographic profile, indicating a broad reach across various segments of society. The gender distribution shows that 62.8% of respondents were female (118 individuals), while 37.2% were male (70 individuals), as presented in Table 1. Equally significant is the diversity in the professional backgrounds of the respondents. Table 2 shows librarians constituted the largest group, representing 50% (94 individuals) of the total participants. This substantial representation underscores the pivotal role of libraries and librarians in promoting public engagement with science. Libraries, as accessible community hubs, play a crucial role in facilitating educational programs, thereby positioning themselves as key players in advancing citizen science.

The presence of students, who made up 18.1 % of the respondents and accounted for 34 individuals, attending the program illustrates its effectiveness in engaging members of the youth population. Furthermore, the general public's presence, which was noted to be 22.3% and constituted 42 individuals, shows that the program can attract non-academic participants, making a significant difference in people's lives. Even though the two last-mentioned population groups had a significantly lower stake in the phenomenon under analysis, with 7.4% and 2.1% of the case, the involvement of scholars and researchers is particularly significant since it allows the program to maintain a high degree of validity. In other words, thanks to the active participation of the cited population group, citizen science initiatives are bound to be profound and carry the weight of relevant and credible academic research. The overall results of the survey suggest that the citizen science program has reached different segments of society, having participated significantly, and these include women, librarians, students, and the public. The growing role of the library as the center of public involvement in science is highlighted. In contrast, the involvement of the academic community and researchers, which is still small, becomes increasingly important in the context of ensuring the scientific quality of the program.

Table 1. Gender distribution of the respondents

Gender	Frequency	Percent (%)
Male	70	37.2
Female	118	62.8
Total	188	100.0

Table 2. Professional backgrounds of the respondents

Type of respondent	Frequency	Percent (%)
Academia	14	7.4
Researcher	4	2.1
Librarian	94	50.0
Student	34	18.1
Public	42	22.3
Total	188	100.0

Factor Analysis and Common Method Bias

Principal Component Analysis (PCA) results show that the first component accounts for 53.53% of the total variance, raising potential concerns about common method bias per Harman's Single-Factor Test. When a single factor explains over 50% of the variance, it suggests that the relationships between variables might be inflated due to the measurement method rather than true relationships among the constructs. However, in this case, while Component 1 explains more than half of the variance, Component 2 accounts for 21.08% and Component 3 for 8.40%, both having eigenvalues greater than 1. This means that these components capture additional variance. The presence of these components indicates that the data is not dominated by a single factor, suggesting that common method bias may be present but is likely minimal.

Changes in Knowledge and Engagement

The research used a pre-and post-test design to measure a change in the knowledge and engagement of participants in regard to citizen science. Thus, before and after the events, the participants were asked to answer a series of questions. They covered a range of different indicators. Initially, participants had to explain the concept of citizen science, their perceptions of how much citizen science contributes to the development of the science, and how confident they can share with other people the information about their knowledge in these areas. They also had to evaluate how important citizen science, in their view, reflects the role of libraries and to what degree it fits the mission and the set of goals of the libraries.

To analyze these changes, the researchers conducted a paired samples t-test. This statistical test compares the means of the participants' responses before and after the events to determine whether any observed differences are statistically significant. The analysis produced two key tables: The Paired Samples Statistics table, which includes the mean, sample size (n), standard deviation, and standard error mean, and the Paired Samples Test table, which reports the t-value and p-value to evaluate the magnitude and significance of the observed effects. Table 3 and Table 4 show the research finding paired sample T-test for Q1 to Q5.

Table 3. Paired sample statistics for Q1 to Q5

Paired Samples Statistics						
Indicators		Situation	Mean	N	Std. Deviation	Std. Error Mean
How would you rate your current level of familiarity with the concept of citizen science?	Q1	Before	3.71	188	1.121	.082
		After	4.34	188	.611	.045
To what extent do you believe citizen science can contribute to the advancement of scientific knowledge?	Q2	Before	4.28	188	.834	.061
		After	4.31	188	.630	.046
How confident do you feel in explaining the principles of citizen science to others?	Q3	Before	3.83	188	1.066	.078
		After	4.16	188	.760	.055
How important is it for libraries to actively engage in citizen science initiatives?	Q4	Before	4.28	188	.853	.062
		After	4.49	188	.580	.042
To what extent do you think citizen science aligns with the mission and goals of libraries?	Q5	Before	4.24	188	.860	.063
		After	4.46	188	.606	.044

Table 4. Paired samples test for Q1 to Q5

Paired Samples Test									
Question	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
				Lower	Upper				
Q1	-.628	1.044	.076	-.778	-.477	-8.241	187	<.001	<.001
Q2	-.027	.904	.066	-.157	.103	-.403	187	.344	.687
Q3	-.335	.895	.065	-.464	-.206	-5.132	187	<.001	<.001
Q4	-.207	.830	.061	-.327	-.088	-3.426	187	<.001	<.001
Q5	-.223	.810	.059	-.340	-.107	-3.783	187	<.001	<.001

To evaluate the changes before and after the event, identical questions were posed to participants and grouped as Q1 through Q5. For Q1, the analysis revealed a mean difference of -0.628, with a t-value of -8.241 and a p-value of <.001. This significant difference indicates that participants' familiarity with the concept of citizen science improved notably after the event. The findings suggest that respondents acknowledged a considerable increase in their knowledge of citizen science following their participation. The strong statistical significance (p-value <.001) reported in Table 3 supports this conclusion, demonstrating that the observed change is unlikely to be due to chance. Moreover, the negative mean difference in Table 4 further confirms that post-event knowledge levels were higher than those before the event, emphasizing the event's success in enhancing participants' understanding of citizen science.

The analysis of Q2 (before and after the event) revealed a mean difference of -0.027, with a t-value of -0.403 and a p-value of .687. This result indicates no statistically significant difference between the scores before and after the event, as reflected by the high p-value. The minimal mean difference suggests that participants' responses were very similar before and after the event. Although there was an overall improvement in knowledge about citizen science, respondents did not significantly agree that citizen science can contribute to the advancement of scientific knowledge. The lack of significant change highlights that this particular measure was either unaffected by the intervention or that the event did not effectively address this area. This means that for future interventions, it may be necessary to focus on demonstrating the actual effect of citizen science on scientific progress, ensuring that participants recognize and appreciate its potential contributions.

The analysis of Q3 (before and after the event) revealed a mean difference of -0.335, with a t-value of -5.132 and a p-value of <.001. These findings imply that before and after the event, there is a significant difference in participants' responses, which suggests that respondents were more confident in explaining the principles of citizen science to others after the event. The observed change is highly reliable. This significant improvement suggests a substantial increase in participants' awareness and willingness to share information about citizen science, likely reflecting enhanced knowledge, perceptions, or engagement following the event. The strong statistical significance underscores the program's effectiveness in positively influencing participants' attitudes and understanding, demonstrating the value of the intervention in promoting favorable outcomes in this area.

The analysis of Q4, comparing data before and after the event, revealed a mean difference of -0.207, with a t-value of -3.426 and a p-value of <.001. These results indicate a statistically significant difference between the scores before and after the event, suggesting that participants' perceptions improved following the event. After attending, respondents strongly believed that libraries should actively engage in citizen science initiatives. This finding is supported by the negative mean difference observed in Table 4, reflecting a positive shift in the area measured by these variables.

The analysis of Q5 (before and after the event) revealed a mean difference of -0.223, with a t-value of -3.783 and a p-value of <.001. This result indicates a statistically significant difference between the scores before and after the event. Similar to Q4, the negative mean difference suggests that post-event scores were generally higher than pre-event scores. This indicates that respondents strongly believe citizen science aligns with the mission and goals of libraries after learning about the initiative. The strong statistical significance for Q5 further underscores the event's effectiveness in positively influencing participants, reinforcing the value of the intervention in achieving the event's objectives. Overall findings demonstrate that the event effectively enhanced participants' familiarity with the concept of citizen science (Q1), confidence in explaining its principles (Q3), and perceptions of its importance in libraries (Q4) and alignment with their mission and goals (Q5), all of which showed statistically significant improvements ($p < .001$). However, participants' views on the contribution of citizen science to scientific advancement (Q2) did not show a significant change, suggesting that this area may require further focus in future interventions.

Citizen Science as Part of the Role of Librarian

Q6 focuses on the role of librarians in citizen science. The respondents were asked how relevant they believe citizen science is to the role of a librarian. Tables 5 and 6 present comprehensive statistical data on this perspective. The researcher conducted a paired samples t-test to examine the respondents' views before and after attending the event. The analysis of the paired sample t-test reveals a mean difference of -0.191, indicating that the values after attending the event are, on average, 0.191 units higher than before. The t-value is -3.160, and the p-value is .002, which is statistically significant at the 0.05 level, as shown in Table 6. This suggests that respondents increasingly believe that citizen science is part of a librarian's role. The negative mean difference confirmed in Table 6 indicates that after attending the event, respondents gained a clearer understanding that librarians should play a role in the citizen science movement. Overall, the finding shows that the program is effective in providing exposure and a deeper understanding of how librarians can play an important role in supporting, promoting, and engaging in citizen science initiatives.

Table 5. Paired sample statistics for Q6

Paired Samples Statistics					
Indicator		Mean	N	Std. Deviation	Std. Error Mean
[Q6] How relevant do you believe citizen science is to the role of a librarian?	Before	4.26	188	.872	.064
	After	4.45	188	.614	.045

Table 6. Paired samples test for Q6

Paired Samples Test									
	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
Q6	-.191	.831	.061	-.311	-.072	-3.160	187	<.001	.002

Willingness to Advocate for Citizen Science

The program successfully enhanced the participants' desire to promote the implementation of citizen science projects in their libraries or offices. The results of the subjects' post-program responses showed an increase in the subjects' readiness to advocate for the use of citizen science in their professional and personal networks. The t-test of the paired samples also shows that the mean difference in the responses is -0.207, which suggests that the post-event values are likely to be 0.207 units more than the pre-event values. These findings affirm a statistically significant difference in the perceived importance of the two variables, a t-value of -3.324 and a statistically significant p-value of .001, suggesting that respondents are now more inclined to advocate for the inclusion of citizen science initiatives within libraries and among librarians. Tables 7 and 8 provide the complete statistical analysis of Q7.

This indicates that the program is helpful in ensuring and motivating the participants to embrace citizen science as an important program that needs to be supported and adopted in libraries. This increased readiness also presents a more knowledgeable attitude towards programmes such as citizen science and the role that they can play in the progress of community and science. Furthermore, evidence of the impact of this program on modifying perception among the participants can also depict a better appreciation and assurance towards the relevance of this program in the library and communities.

Table 7. Paired sample statistics for Q7

Paired Samples Statistics					
		Mean	N	Std. Deviation	Std. Error Mean
[Q7] How likely are you to advocate for the incorporation of citizen science initiatives within your library?	Before	4.25	188	.881	.064
	After	4.46	188	.579	.042

Table 8. Paired samples test for Q7

Paired Samples Test									
	Paired Differences					t	df	Significance	
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				One-Sided p	Two-Sided p
Q7	-.207	.856	.062	-.331	-.084	-3.324	187	<.001	.001

Discussion

The study has a significant contribution to science and understanding of the role of NGOs like PPM and academic libraries in promoting citizen science. It can be concluded that after the program, the knowledge of the participants about citizen science has increased to a great extent. Moreover, they are now more willing to get actively engaged in citizen science. Rammutloa's (2023) study has found that to participate effectively in citizen science, academic librarians must have information literacy, data literacy, and open science knowledge. This proves that education provided by NGOs and public libraries can improve science literacy in society. Therefore, this study supports the idea that libraries can serve as an important connection in the contemporary citizen science movement that can largely connect society to scientific knowledge.

The current study has contributed to the existing knowledge that stakeholder interaction between NGOs, libraries, and the community is key in informing the continued engagement and sustaining of citizen science. Additionally, Che Jaafar's (2024) study adds to the current knowledge that the stakeholder interaction was successful, stating the practice of students, faculty, and staff as a campus community in running the citizen science program.

Furthermore, the finding confirms the significance of cross-sector collaboration in supporting the success and sustainability of citizen science programs as seen in various contexts, including conservation efforts and public health responses (Cervantes-Rosas et al., 2022; Soria et al., 2023). In addition, the study suggests that citizen science can be enhanced if more cooperation is maintained between NGOs, libraries, and the community. The examples and models of such cooperation that are brought in the study are likely to serve as the basis for developing more sustainable citizen science projects.

These findings provide important insights for future policy development and practice in citizen science initiatives in Malaysia, emphasizing the importance of continued collaboration between NGOs, libraries, and communities to ensure greater community involvement in these projects.

Conclusion

The study's results indicate that the 'Bridging Worlds: Libraries as Connectors in Citizen Science' program effectively improved participants' understanding and involvement in citizen science. This is particularly clear from the fact that they were aware of the fact that libraries play a highly significant role in the discussed projects. Increased awareness and understanding of the sphere by the participants is an important indicator of the effectiveness of the program regarding librarians' participation in advocating, promoting, and doing citizen science. The improved preparedness of librarians is also proof of a higher level of understanding of the advantage of citizen research and its possible effects on the development of communities and science itself. Nonetheless, the answers provided by the respondents concerning the concrete outcome of citizen science for scientific progress (Q2) did not reveal a significant change, which points to the notion that this issue should be further discussed in the next interventions. This suggests that while the initiative was effective in raising awareness of citizen science, perhaps more emphasis needs to be placed on demonstrating how citizen science actually helps drive science forward.

Therefore, it is useful for future programs to include such specific segments that stress the direct impact of citizen science on scientific processes. To improve comprehension of the role of citizen research in the growth of science, it is important to incorporate real-life incidents, case

studies, as well as interactions with the scientists. Moreover, it is vital to establish and maintain continual monitoring and feedback systems to consistently evaluate and address participants' comprehension of these contributions.

Overall, the success of the program in supporting better understanding and engagement with citizen science is a good foundation for future programs. In the future, other programs should look into how the library can further its support of librarians and their involvement in citizen science and what they can do to strengthen their role in the movement and their contribution to the larger scientific community.

Acknowledgments

The authors express gratitude and thanks to the Librarians Association of Malaysia, particularly the Committee on Regional and International Relations (JKPSA); the U.S Embassy Kuala Lumpur; American Corners Malaysia; the Department of Library and Information Science, Faculty of Arts and Social Sciences, Universiti Malaya; the Digital Scholarship and Information Commons Department (Library), Universiti Malaya; Al-Bukhari Library, UiTM Pahang, Jengka Campus; Dar Al-hikmah Library, IIUM Kuantan; The Office of Library and Knowledge Management, the University of Malaysia Kelantan; Pustaka Negeri Sarawak; Perbadanan Perpustakaan Awam Pahang; Organization Biodiversity Club (ORBID), UiTM Pahang; and the Committee Program "Bridging Worlds" for making this programme and project successful.

References

- Azhima, M. N., Elfitra, E., & Indraddin, I. (2022). Application of the three Rothman empowerment models in community empowerment activities by three NGOs in West Sumatera. *Jurnal Ilmu Sosial Mamangan*, 11(2), 107-116. <https://doi.org/10.22202/mamangan.v11i2.6152>
- Cervantes-Rosas, O., Hernández-López, J., Verduzco-Zapata, G., Pérez-Morales, A., García-Villalvazo, P., Quijano-Scheggia, S., & Olivos-Ortiz, A. (2022). Citizen Science Contributions to the Conservation of Sea Turtles Facing Port City and Land Use Stressors in the Mexican Central Pacific. *Coasts*, 2(1), 3.
- Che Jaafar, C. R., Ghazali, M. M., Ismail, M. I., Azmi, N. A., Md Akil, M. A. M., & Ruppert, N. (2024). Universiti Sains Malaysia Campus Nature Challenge: A Collaborative Citizen Science Initiative For Biodiversity Conservation And Environmental Awareness . *PaperASIA*, 40(3b), 33–41. <https://doi.org/10.59953/paperasia.v40i3b.77>
- European Commission (2020) *Citizen Science: Elevating Research and Innovation Through Societal Engagement*. Luxembourg: Publications Office of the European Union. Available at: <https://data.europa.eu/doi/10.2777/624713>
- Gupta, A., Talluri, S. G., & Ghosh, S. (2024). Inclusive science communication approaches through an equity, diversity, inclusion, and social justice (EDISJ) lens. *Issues in Science and Technology Librarianship*, <https://doi.org/10.29173/istl2810>
- Harrington, E.G. (2019). Citizen Science. *Academic Libraries and Public Engagement with Science and Technology*.
- Kowalska-Chrzanowska, M. (2024). Involvement of polish libraries in citizen science. *Journal of Librarianship and Information Science*, 0(0). <https://doi.org/10.1177/09610006241265097>
- Mumelas, D., & Martek, A. (2024). Benefits of citizen science for libraries. *Publications*, <https://doi.org/10.3390/publications12010008>

- Ramonienè, L. (2023). NGOs and stakeholder cooperation in long term care organizing and delivery: an equal player or an outlier?. *SocioEconomic Challenges*, 7(1), 31-43. [https://doi.org/10.21272/sec.7\(1\).31-43.2023](https://doi.org/10.21272/sec.7(1).31-43.2023)
- Rammutloa, M. W. (2023). The missing link: The capacity development for academic librarians to sustain citizen science at university libraries. *Library Management*. <https://doi.org/10.1108/lm-03-2023-0014>
- Robinson LD, Cawthray JL, West SH, et al. (2018) Ten principles of citizen science. In Hecker S, Haklay M, Bowser A, et al. (eds) *Citizen Science—Innovation in Open Science, Society and Policy*. London: UCL Press, pp. 27–40.
- Soria, C., Almirón, W., Stewart-Ibarra, A. M., & Crocco, L. (2023). Systematic literature review about educational interventions evaluated through entomological indices or practices to prevent the presence of or eliminate breeding sites of *Aedes*. *Biorxiv*.
- Tzovaras BG (2024) Open Science meets citizen science. LIBER Citizen Science Working Group. Available at: <https://cs4rl.github.io/open-science/>
- United Nations Educational, Scientific and Cultural Organization (UNESCO) (2021) UNESCO Recommendation on Open Science. Paris: UNESCO. Available at: <https://unesdoc.unesco.org/ark:/48223/pf0000379949>