Malaysian University Librarians' Inclination towards Citizen Science

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ABSTRACT

Libraries have been at the forefront of Open Science, of which Citizen Science is a one of the pillars for success. However, the literature reveals that the uptake of Citizen Science projects by university librarians in the South East Asian countries is lacking. This study aims to ascertain Malaysian university librarians' inclination towards citizen science projects at their campus. The study takes a quantitative approach using the survey method. Data is collected in two instances. (i) the current engagement level determined at multiple dimensions of cognitive, affective, social, behavioral and personal motivates; (ii) the possible roles and responsibilities in a citizen science project as librarians envisage. The population under study are librarians at all public universities in Malaysia. 321 responses were received through a survey conducted in April 2023. The findings reveal that only a small number of librarians are actively involved in citizen science projects at their respective universities, mainly as project managers or data stewards. As for possible roles in the future, it was hopeful of revealing that the majority of the librarians were very positive towards their ability to contribute on all cognitive, social, behavioral and personal levels to seek opportunities for future involvement in citizen' science to promote active citizenship among university campus society.

Keywords: Citizen Science; Open Science; Librarians; Academic Library; Malaysia

INTRODUCTION

The scientific community increasingly embraces the objectives of open science and citizen science, two related research and public outreach programmes. An important component of open science is the participation of social actors and knowledge-producing organizations in scientific research and decision-making processes. On the other hand, citizen science refers to amateur scientists participating openly and regularly under supervision in scientific research projects (Eitzel et al. 2017). The terms "open science" and "citizen science" are sometimes used interchangeably, but the two ideas have different goals and characteristics.

Libraries have been at the forefront of Open Science, which includes citizen science as a strong pillar for success. Libraries have the opportunity to present the infrastructure, information literacy skills, including research skills, data management, and most importantly,

develop resilient societies that are knowledgeable and able to actively contribute to scientific research. Furthermore, a research guide on open science and citizen science emphasizes the integrated model of public knowledge production and engagement with science(Knack 2017). Another study explored the role of citizens in open science and their research contributions, emphasizing the importance of openness, transparency, and access to knowledge (Roche et al. 2020). However, the literature reveals that the uptake of Citizen Science projects by university librarians in the South East Asian countries is lacking (Kaarsted et al. 2023). Though, certain programmes and suggestions point to the possibility of the emergence of such networks or organizations.

For instance, academic libraries can support citizen science efforts by providing tools and resources to advance scientific and information literacy (Cohen et al. 2015). Additionally, libraries are encouraged to play a part in fostering citizen science and providing assistance and direction to librarians who are enthusiastic in taking part in citizen scientific programmes (CEPAL 2023). Even while these projects and suggestions do not expressly identify any current networks or organizations, they do suggest that librarians who are interested in citizen science need more assistance and resources. As interest in citizen science among Southeast Asian librarians increases, it is feasible that similar networks or organizations will form in the future. We intend to add to the body of knowledge by conducting this study on Malaysian university librarians' propensity for citizen science initiatives and to offer insights that can guide strategies to encourage librarians' active participation in such projects. Recognizing areas for improvement and facilitating the creation of efficient support systems within academic libraries to encourage citizen scientific participation will be made possible by understanding librarians' levels of engagement and their anticipated roles.

LITERATURE REVIEW

CITIZEN SCIENCE

According to the Oxford English Dictionary (2014), the first recorded use of the word"citizen science" in its current form dates back three decades (Oxford English Dictionary 2014). Citizen science was added to the Oxford English Dictionary in 2014, and it is defined as scientific work carried out by members of the general public, often in collaboration with or under the direction of professional scientists and scientific institutions (Oxford English Dictionary 2016). The term first appears in the January 1989 issue of the MIT Technology Review. The article 'Lab for the Environment' discusses three examples: community-based laboratories that investigate environmental risks, Greenpeace's laboratory work, and Audubon's recruitment of volunteers for a 'citizen science' program (Haklay et al. 2021). Moreover, citizen science, in its broadest sense, refers to the active participation of the general population in scientific research projects. Citizen science is a rising discipline in which scientists and citizens work together to create new scientific and societal knowledge (Vohland et al. 2021).

According to the definition developed by the Open Science Policy Platform (OSPP), broadly defined, citizen science is scientific work undertaken by members of the public, often in

collaboration with or under the direction of professional scientists and scientific institutions. Citizen science is an already very diverse practice, encompassing various forms, depths, and aims of collaboration between academic and citizen researchers and a broad range of scientific disciplines. Civic participation in research can range from short-term data collection to intensive involvement in the research process, from technical contribution to genuine research, and collaboration to co-creation of knowledge. For this study, the definition by OSPP is the most accurate and related to the research objective.

A citizen science project can involve a single person or millions of individuals working together to achieve a common goal. Generally, public participation occurs through data collection, analysis, or reporting (SciStarter 2020). There are four common features of citizen science practice: (a) anyone can participate, (b) participants use the same protocol so data can be combined and be high quality, (c) data can help real scientists come to real conclusions, and (d) a wide community of scientists and volunteers work together and share data to which the public, as well as scientists, have access (Flagg 2016). While all these definitions have some aspects in common – most notably the concept of a public that participates in an activity known as scientific inquiry - the majority of them are vague and susceptible to interpretation (Haklay et al., 2021). As a conclusion to the concept of citizen science, the most popular terms that are associated with it are "community science," "amateur science," "crowdsourced science," "volunteer monitoring," and "public participation in scientific study."A growing global movement, citizen science welcomes participation from individuals, groups of friends and family, community organizations, and anyone else. In addition to developing research questions, producing and sharing observations, and interpreting and disseminating project outcomes, this crowdsourced, collaborative project may also involve obtaining, analyzing, and analyzing data (Scistarter, 2020).

CITIZEN SCIENCE AND LIBRARIES

Citizen science is now recognised as a transformational strategy that engages communities in sociopolitical processes, empowers individuals, and advances scientific research (von Gönner et al. 2023) Public libraries have embraced citizen science programmes as community centers to rethink their place in society (Cigarini et al. 2021). However, the literature demonstrates both benefits and drawbacks of citizen science incorporation in library contexts. The potential of citizen science to reinvent public libraries as community-driven organizations is highlighted in a research that examines the benefits and drawbacks of citizen science in public libraries (Cigarini et al. 2021). The study ses the value of citizen science in encouraging neighborhood engagement and improving library patrons' scientific literacy. It also points out difficulties including resource shortages and the requirement for training and assistance for library employees to successfully undertake citizen science programmes.

Academic libraries are becoming increasingly aware of the opportunities for citizen science participation. By involving stakeholders and legitimizing their participation in the design and collection of research data, citizen science projects, according to studies, can enhance the quality of decision-making processes (von Gönner et al. 2023). This shows how academic

libraries have the opportunity to help citizen science projects that encourage the use of evidence when making decisions.

Furthermore, studies have explored the potential for academic libraries to incorporate citizen science into their instructional practices. Collaborating with faculty, libraries can provide workshops and consultations to support research assignments and guide students in incorporating citizen science methodologies (Halpern 2020). This demonstrates the potential for libraries to integrate citizen science into their educational initiatives and enhance information literacy skills among students. Another study that identifies citizen science prospects for academic libraries emphasizes the need for training and educational programmes to assist librarians in integrating citizen science into their library services. This emphasizes how crucial it is to give librarians the knowledge and abilities they need to participate in citizen science initiatives and assist users and researchers in this field (Cohen et al. 2015; Kaarsted et al. 2023)

Another study highlights the potential of citizen science to open up new avenues for research and knowledge creation by positioning it as a top research field in information quality (Lukyanenko, Wiggins, and Rosser 2020). It emphasizes how crucial it is to value citizen science as a source of knowledge and the role libraries play in ensuring the reliability and correctness of citizen science data.

In general, the literature demonstrates that citizen science offers libraries—academic and public—the opportunity to engage communities, improve scientific literacy, and support evidence-based decision-making. However, problems including a lack of resources and the need for staff assistance and training must be addressed. By embracing citizen science and implementing it into their services and teaching practices, libraries may play a significant role in encouraging citizen involvement, advancing scientific research, and helping to build resilient communities.

RESEARCH DESIGN

(a) Study design and sampling

From February 2023 to April 2023, a cross-sectional was conducted among librarians who were working at Malaysia public universities. Malaysia has 20 public universities with a population of 642 librarians. All librarians from Gred S41- S54 and Jusa C were invited to participate in this study through an e-mail. Participants can be librarians who have previously participated in CS projects, as well as those who have not yet been involved but are interested in doing so if provided with the chance. They were asked to complete a Google Forms survey. Follow-up survey invitations were sent twice to increase participation.

(b) Ethical consideration

This study was approved by the University of Malaya Research Ethics Committee (UM.TNC2/UMREC_2399). Participants were informed that their participation was voluntary.

Participants had to click "Yes, I consented to engage in this study" in order to give their permission to participate.

(c) Instrument

The study used the Dimensions of Engagement framework by Phillips et al. 2019 to measure the engagement of Malaysian librarians in citizen science. The instrument consisted of demographic information sections and 37 items to represent the five dimensions of engagement; 1) Behavioural, 2) Motivation, 3) Affection, 4) Social Connections and 5) Cognitive The participants were first asked if they had been involved in any citizen science project at their respective campus. Those who answered YES were then directed to questions about their active involvement, while those who answered NO were directed to questions on their perception of engagement.

i) Behavioral

The participant's current engagement level and possible involvement in a project in terms of what they did or would do were assessed using 13 items for each domain. The response options for the current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total behavioral score ranged from 0 to 13, with higher scores representing higher levels of tasks they did or would do in a CS project.

ii) Motivation

In this section, the participant's current engagement level and possible involvement in a CS project in terms of what motivated/ would motivate them to be involved were assessed using 6 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. Item 6 "I did it because my job demanded it" / "I would do it if my job demanded it" was reverse coded. The possible total motivation score ranged from 0 to 6, with higher scores representing higher motivation they had or they would have to do a CS project.

iii) Affection

The participant's current engagement level and possible involvement in a project in terms of their feelings about a CS project were assessed using 5 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total affection score ranged from 0 to 5, with higher scores representing positive feelings about a CS project.

iv) Social Connections

The participant's current engagement level and possible involvement in a project in terms of their interaction with others were assessed using 5 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options

for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total social connections score ranged from 0 to 5, with higher scores representing positive interaction with others in a CS project.

v) Cognitive

The participant's current engagement level and possible involvement in a project in terms of their learning were assessed using 8 items for each domain. The response options for current engagement level in a project were "yes" and "no". The response options for possible involvement in a project were "yes", "no", and "undecided". A "yes" response was given a score of 1 and an "no" or "undecided" response was scored 0. The possible total affection score ranged from 0 to 8, with higher scores representing positive learning in a CS project.

Statistical analysis

All statistical analyses were performed using the Statistical Package for the Social Sciences, version 26.0 (IBM Corp., Armonk, NY, USA). A p-value of less than 0.05 was considered statistically significant. The scales' reliability was evaluated by assessing the internal consistency of the items representing the scores. The behavioral, motivation, affection, social connections and cognitive items had a reliability (Cronbach's α) of 0.902, 0.801, 0.705, 0.744, and 0.841. The high Cronbach's α value indicates all domains have satisfactory level of internal consistency. Descriptive statistics were computed on the dependent and independent variables. Frequency tables, charts, and proportions were used for data summarisation. The score distributions were checked for underlying assumptions of normality using the Kolmogorov-Smirnov test and Shapiro-Wilk test; as all the score distributions were not normally distributed, non-parametric tests were used. The Mann-Whitney U test and the Kruskal-Wallis test were used to compare medians. Spearman's correlation coefficient was used for correlation analyses.

RESULTS

A total of 318 complete responses were received. The participant characteristics are shown in Table 1. Less than 5% (n=14) of the study participants have been involved in a CS project.

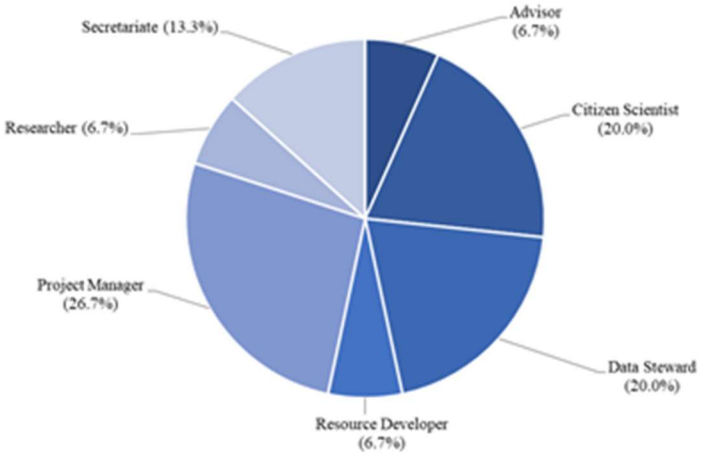
Table 1: Participants' characteristics

	Overall (N=318)	Involved in CS project (n=14)	Not involved in CS project (n=304)
Duration of experience (years)			
<1	15 (4.7)	2 (14.3)	13 (4.3)
1-5	29 (9.1)	0 (0.0)	29 (9.5)
6-10	43 (13.5)	1 (7.1)	42 (13.8)
>10	231 (72.6)	11 (78.6)	220 (72.4)
Position Grade			

S41	80 (25.2)	3 (21.4)	77 (25.3)
S44	170 (53.5)	7 (50.0)	163 (53.6)
S48	45 (14.2)	3 (21.4)	42 (13.8)
S52 and above	23 (7.2)	1 (7.1)	22 (7.2)
Highest education level			
Undergraduate	130 (40.9)	4 (28.6)	126 (41.4)
Postgraduate	188 (59.1)	10 (71.4)	178 (58.6)

Figure 1 shows the distribution of roles of study participants in the previous CS project. Most of those involved in a CS project held a project manager post (26.7%, n=4). Most of the CS projects they had conducted were astronomy and spaced-themed projects (19.2%, n=5).

(A) Roles in the previous CS



(B) CS project themes

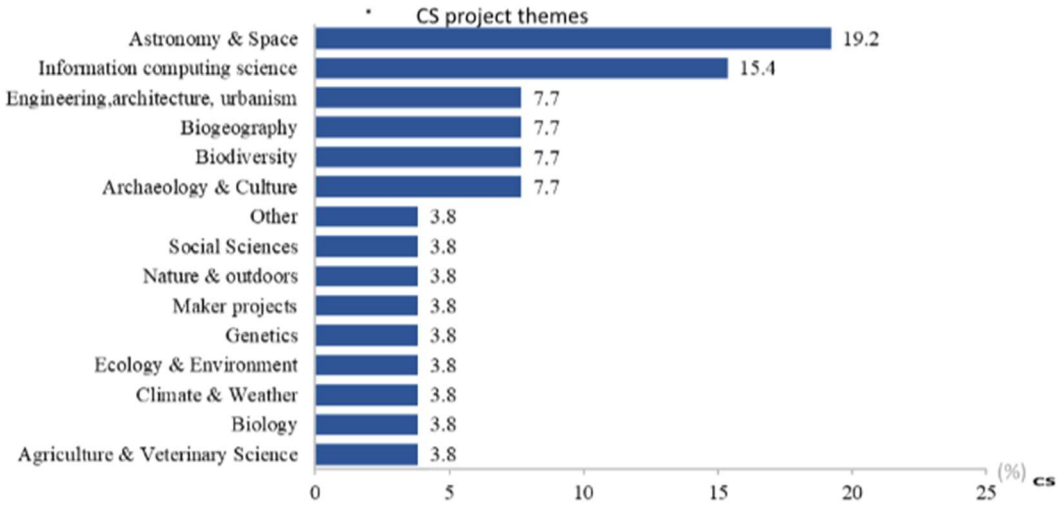


Figure 1: Distribution of Roles & Theme of Study Participants in the Previous CS Project

Figure 2 shows the distribution of "yes" responses for behavioral, motivation, affective, social connections and cognitive items among study participants who had been involved in a CS project. Almost two-thirds reported that they had attended meetings related to the project and communicated the general information about the project to others. All study participants (100%) reported that they were willing to contribute to science or education or community and collaborate or interact socially with others. Additionally, every study participant engaged in new behaviors and activities as a result of their engagement, learned new tool use via practise, and expanded their knowledge through interactions with others. A total of 85.7 percent said they had participated in the CS project due to their concern for the data quality, particularly accuracy in data collecting.

Figure 3 shows the distribution of "yes" responses for behavioural, motivation, affective, social connections and cognitive items among study participants who were not involved in a CS project. Almost 80% of the study participants reported that they would be attending meetings related to the project, finding supporting information to defend the evidence found and collecting data. The majority (92%) of the study participants are willing to contribute to science, education, or community. A total of 85% reported that they would get involved in a CS project if their job demands it. More than 80% reported that they would get involved in a CS project because of their dedication to the idea, the project, the environment, or the science behind the project and their concern for data quality, especially accuracy in data collection. Slightly more than 90% of the study participants would get involved in a CS project because of their willingness to collaborate or interact with others. 95% of the study participants believed they could learn from direct observation or hands-on experience with the project and increase their knowledge through interactions with others.

Figure 2: Distribution of "Yes" Responses for Behavioural, Motivation, Affective, Social Connections and Cognitive Items among Study Participants Who Had Involved in a Cs Project (N=14)

Figure 3: Distribution of "Yes" Responses for Behavioural, Motivation, Affective, Social Connections and Cognitive Items among Study Participants Who Have Not Involved in a CS Project (N=304)

Table 2 compares the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics. Overall median score for behavioral, motivation, affective, social connections and cognitive was 4.0 [interquartile range (IQR) 2.8-8.5], 5.0 [4.0-5.3], 4.0 [2.5-5.0], 4.5 [4.0-5.0] and 8.0 [6.8-8.0], respectively. There was no significant difference found between median scores by participants' characteristics in all domains.

Table 2: Comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics

		Current Engagement Level in a previous CS project				
		Total Behavioral Score Median (IQR)	**Total Motivation Score Median (IQR)**	**Total Affective Score Median (IQR)**	**Total Social Connections Score Median (IQR)**	**Total Cognitive Score Median (IQR)**
Overall		4.0 (2.8, 8.5)	5.0 (4.0, 5.3)	4.0 (2.5, 5.0)	4.5 (4.0, 5.0)	8.0 (6.8, 8.0)
Participants' characteristics						
Duration of experience (years)						
<1	2 (14.3)	9.0 (8.0, 10.0)	5.0 (5.0,5.0)	4.5 (4.0, 5.0)	4.0 (4.0, 4.0)	7.0 (6.0, 8.0)
1-5	0 (0.0)	-	-	-	-	-
6-10	1 (7.1)	-	-	-	-	-
>10	11 (78.6)	3.0 (2.5, 5.5)	5.0 (4.5, 5.5)	4.0 (2.0, 5.0)	5.0 (4.0, 5.0)	8.0 (7.5, 8.0)
p-value		0.073	1.000	0.411	0.391	0.397
Position Grade						
S41	3 (21.4)	10.0 (9.0, 10.5)	5.0 (4.5, 5.0)	4.0 (4.0, 4.5)	4.0 (4.0, 4.5)	6.0 (6.0, 7.0)
S44	7 (50.0)	3.0 (2.5, 4.0)	5.0 (4.5, 5.0)	3.0 (1.0, 3.5)	4.0 (3.0, 4.5)	8.0 (7.5, 8.0)
S48	3 (21.4)	7.0 (4.0, 9.0)	5.0 (4.0, 5.5)	5.0 (5.0, 5.0)	5.0 (5.0, 5.0)	8.0 (7.5, 8.0)
S52 and above	1 (7.1)	-	-	-	-	-
p-value		0.124	0.520	0.071	0.175	0.444
Highest education level						
Undergraduate	4 (28.6)	6.5 (2.0, 10.5)	5.0 (4.5, 5.5)	4.5 (4.0, 5.0)	5.0 (4.5, 5.0)	8.0 (7.0, 8.0)
Postgraduate	10 (71.4)	4.0 (3.0, 7.0)	5.0 (4.0, 5.0)	3.5 (1.0, 5.0)	4.0 (4.0, 5.0)	8.0 (7.0, 8.0)
p-value		0.775	0.704	0.185	0.215	0.740

Table 3 shows the comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics. Overall median

score for behavioral, motivation, affective, social connections and cognitive was 9.0 [interquartile range (IQR) 6.0-13.0], 5.0 [4.0-5.0], 4.0 [3.0-5.0], 5.0 [3.0-5.0] and 8.0 [7.0-8.0], respectively. Similarly, there was no significant difference found between median scores by participants' characteristics in all domains.

Table 3: Comparison of the median (IQR) score for each domain of Current Engagement Level in a previous CS project by participants' characteristics

		Possible involvements in a CS project				
		Total Behavioral Score Median (IQR)	**Total Motivation Score Median (IQR)**	**Total Affective Score Median (IQR)**	**Total Social Connections Score Median (IQR)**	**Total Cognitive Score Median (IQR)**
Overall		9.0 (6.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
Participants' characteristics						
Duration of experience (years)						
<1	13 (4.3)	8.0 (5.0, 13.0)	5.0 (4.0, 5.0)	5.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
1-5	29 (9.5)	9.0 (7.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
6-10	42 (13.8)	8.0 (6.0, 13.0)	5.0 (5.0, 5.0)	5.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
>10	220 (72.4)	9.0 (5.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
p-value		0.801	0.599	0.335	0.795	0.809
Position Grade						
S41	77 (25.3)	9.0 (6.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
S44	163 (53.6)	9.0 (5.0, 13.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
S48	42 (13.8)	9.0 (6.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (7.0, 8.0)
S52 and above	22 (7.2)	7.5 (4.0, 11.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
p-value		0.629	0.738	0.707	0.839	0.498
Highest education level						
Undergraduate	126 (41.4)	8.5 (5.0, 12.0)	5.0 (4.0, 5.0)	4.0 (3.0, 5.0)	5.0 (3.0, 5.0)	8.0 (7.0, 8.0)
Postgraduate	178 (58.6)	9.0 (6.0, 13.0)	5.0 (4.0. 5.0)	4.0 (3.0, 5.0)	5.0 (4.0, 5.0)	8.0 (8.0, 8.0)
p-value		0.775	0.704	0.185	0.215	0.740

Among the study participants who had been involved in a CS project, Spearman rank order correlations showed that motivation scores were positively related to cognitive scores ($r = 0.590$, $n = 14$, $p < 0.05$). Affective score is also positively related to social connections scores ($r = 0.735$, $n = 14$, $p < 0.01$). Among those who have not been involved in a CS project, all domains are positively correlated with each other.

Table 4: Spearman rank order correlations

	Current Engagement Level in a previous CS project (N=14)				
	Behavioral	Motivation	Affective	Social Connections	Cognitive
Behavioral	-				
Motivation	0.039	-			
Affective	0.385	0.185	-		
Social Connections	0.266	0.297	0.735**	-	
Cognitive	-0.349	0.590*	0.085	0.037	-
	Possible involvements in a CS project (N=304)				
	Behavioral	Motivation	Affective	Social Connections	Cognitive
Behavioral	-				
Motivation	0.370**	-			
Affective	0.503**	0.463**	-		
Social Connections	0.514**	0.452**	0.630**	-	
Cognitive	0.409**	0.441**	0.464**	0.564**	-

DISCUSSION

The study found that Malaysian public university librarians were not actively participating in citizen science projects at their respective universities. According to the study, of those involved in a citizen science project, the majority held project manager post, and most of the citizen science projects they had conducted were astronomy and space-themed projects. A total of 85.7 percent said they participated in the CS project because they were worried about the data quality, particularly the accuracy of the data gathering.Citizen science initiatives may use quality assessment and quality control (QA/QC) procedures to overcome these issues and guarantee the accuracy of the data. These actions could involve participant education and assistance, standardized data collection techniques, and data validation and verification (Follett and Strezov 2015; Downs et al. 2021). By offering participants training and support, addressing legal and ethical concerns, and putting quality assessment and quality control methods in place, libraries and librarians can play a significant part in assuring data quality in citizen science projects. (Follett and Strezov 2015; Gabriele and Eva-Maria 2016; Downs et al. 2021). Maintaining the quality of the data is essential to citizen science initiatives. Citizen

science initiatives can provide more accurate and reliable data by enhancing data quality, resulting in better scientific findings and decision-making.

Several interesting findings were found among study participants who were never involved in CS projects. The study revealed that even though they never had experience in any CS project, they are receptive to future involvement in citizen science projects. They are confident in their ability to collect data, find research resources, and attend meetings related to the project. However, librarians have not yet fully realized their ability to advance beyond their usual job duties. The majority of librarians lack the confidence necessary to assume the role of a "researcher" who is capable of designing the study, developing hypotheses and research questions, and even assessing data.. Additionally, they did not consider themselves as project participants' recruiters or trainers. This can be as a result of their lack of self-perception as project managers or owners. However, research found that engaging in citizen science initiatives gave university libraries the chance to foster a positive attitude toward scientific inquiry (Cohen et al. 2015).

Libraries and librarians can play a crucial role in ensuring data quality in citizen science projects by providing participant training and support, identifying legal and ethical issues, and implementing quality assessment and quality control measures. The study suggests a need to enhance their confidence in research methodology-related roles.

The present study revealed that librarians were concerned with data quality and accuracy. Public university librarians are confident in being able to contribute to the citizen science project, but would not seek recognition for doing their task. As librarians are service-oriented, there is no inclination towards recognition of a task that is obvious to them as part of their service to the university community. Librarians play a crucial role in managing research data, which is a part of their role in supporting researchers. However, in citizen science projects, managing data is still a new area and requires specific training because data quality is one of the crucial issues in citizen science projects. Several studies have identified research data management challenges in citizen science projects and recommended that university libraries focus their services on identifying legal and ethical issues, adhering to the FAIR principles, and ensuring data quality (Gabriele and Eva-Maria 2016; Balázs et al. 2021; Hansen et al. 2021;). Increased data reliability and accuracy from citizen science initiatives can result in better scientific findings and decision-making (Cigarini and Bonhoure 2022).

The survey also discovered that librarians at public universities are driven to participate in citizen science initiatives because they want to help communities become more knowledgeable about and empowered by environmental issues. Surprisingly, a few librarians were unsure about the part they could play in exposing pupils to the environment, despite the fact that the majority would do it because their profession required it.

CONCLUSION

In conclusion, public university librarians are open to participating in citizen science initiatives because they think their present knowledge and abilities can help with information sharing and resource-based services. However, there are new roles that they may be willing to try, such as involvement in research design and methodology, project management, and increased social responsibility. To achieve this, librarians need to be motivated to be concerned about student learning and have increased feelings about the purpose of citizen science projects and go beyond their routine job tasks. The primary duties that librarians could do include activity promotion and participant recruiting. Although it may be difficult to provide research tools, particularly technical resources, librarians have the power to instruct in research skills. Academic libraries and university citizen science project managers that want the initiatives to flourish with more engagement from society members may find the study's conclusions helpful. The instrument used in the study offers university librarians a method to gauge their current level of engagement with citizen science projects and address the gaps to elevate their active involvement shortly. Future studies could compare the findings of this study with other countries in Southeast Asia to infer generalizations across institutions.

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