

Surveying the Open Science Knowledge in a Southern Brazilian University

Edson Oliveira Jr
edson@din.uem.br
Informatics Department – State
University of Maringá (UEM)
Maringá, Paraná, Brazil

André F. R. Cordeiro
cordeiroandrefelipe@gmail.com
Informatics Department – State
University of Maringá (UEM)
Maringá, Paraná, Brazil

Danillo Nascimento
danillodiasnascimento@gmail.com
Informatics Department – State
University of Maringá (UEM)
Maringá, Paraná, Brazil

ABSTRACT

Open Science can be seen as a movement that has been spread out by the scientific community of all areas. In this movement, practices that seek to facilitate the sharing of research artifacts are considered. Possible artifacts include articles, data, scripts, and processes. In this paper, we present and discuss the results of a survey on open science carried out in the context of the State University of Maringá (UEM) in Brazil. Such a survey is aimed at investigating the degree of knowledge about open science from lecturers who supervise Master's degree students and PhD candidates. The university has currently 54 graduate programs, distributed in different centers, encompassing almost 900 lecturers. We collected data using a web questionnaire with 22 questions. In total, 90 lecturers answered our survey. Results show that a significant subset of respondents never heard about open science, whereas the complementary subset barely dealt with the open science principles, tools or license types. We then provide in this paper a set of assumptions on several open science-related subjects. In addition, this paper might be used to guide any other university to measure the degree level of open science knowledge and to provide a plan to inspire the institutionalization of such an extremely relevant scientific topic.

CCS CONCEPTS

• **General and reference** → **Surveys and overviews; Empirical studies; General literature.**

KEYWORDS

open science, knowledge awareness, researchers, practices, experiences, adoption, obstacles

ACM Reference Format:

Edson Oliveira Jr, André F. R. Cordeiro, and Danillo Nascimento. 2022. Surveying the Open Science Knowledge in a Southern Brazilian University. In *The 18th International Symposium on Open Collaboration (OpenSym 2022)*, September 7–9, 2022, Madrid, Spain. ACM, New York, NY, USA, 10 pages. <https://doi.org/10.1145/3555051.3555064>

Permission to make digital or hard copies of all or part of this work for personal or classroom use is granted without fee provided that copies are not made or distributed for profit or commercial advantage and that copies bear this notice and the full citation on the first page. Copyrights for components of this work owned by others than ACM must be honored. Abstracting with credit is permitted. To copy otherwise, or republish, to post on servers or to redistribute to lists, requires prior specific permission and/or a fee. Request permissions from permissions@acm.org.

OpenSym 2022, September 7–9, 2022, Madrid, Spain

© 2022 Association for Computing Machinery.

ACM ISBN 978-1-4503-9845-9/22/09...\$15.00

<https://doi.org/10.1145/3555051.3555064>

1 INTRODUCTION

Open Science (OS) supports an outstanding perspective for scientific work, favoring an interactive and collaborative development, related to the acquisition, production, and dissemination of knowledge to every citizen [7]. This interactive and collaborative development offers important benefits for the scientific community and the general public. For researchers, it is possible to clearly observe the following benefits: visibility for the research carried out, visibility for the researcher, research partnership opportunities, and opportunities to obtain resources [2, 3].

According to the FOSTER Open Science initiative¹, OS is about extending the principles of openness, especially an emphasis on transparency and collaboration [6], to the whole research cycle (i.e., hypothesis, data collection, processing, storing data and results, long-term preservation, publication and distribution, and reuse), fostering sharing and collaboration as early as possible, thus entailing a systemic change to the way science and research is done. Thus, OS might be considered an umbrella term, which encompasses movements to remove barriers for sharing any kind of output, resources, methods or tools, at any stage of the research process.

The main principles of OS are as follows (Figure 1). **Open Access** to revised content, free of charge and with copyright restrictions. **Open Data** refers to accessible data, which can be used, reused and distributed, as long as the data source is cited. **Open Reproducible Research** means practice of OS, to allow free access to experimental elements, for scientific reproduction. **Open Science Evaluation** represents open evaluation of scientific results, not limited to a set of reviewers, in which the entire scientific community might participate. **Open Science Policies** are guidelines for applying OS and achieving the associated fundamental goals. **Open Science Tools** can aid in the process of building and applying OS.

As we have observed from the increasing OS movement in the last years researchers should be prepared to become promoting agents towards open researching by knowing the minimum set of definitions and principles of the movement to face prospectively new challenges. For instance, Dutch universities are enforcing and awarding researchers carrier promotion based on their commitments on OS [8]. Other perspectives rely on funding agencies requiring OS practices for submitted research projects as in the

¹<https://www.fosteropenscience.eu/content/what-open-science-introduction>

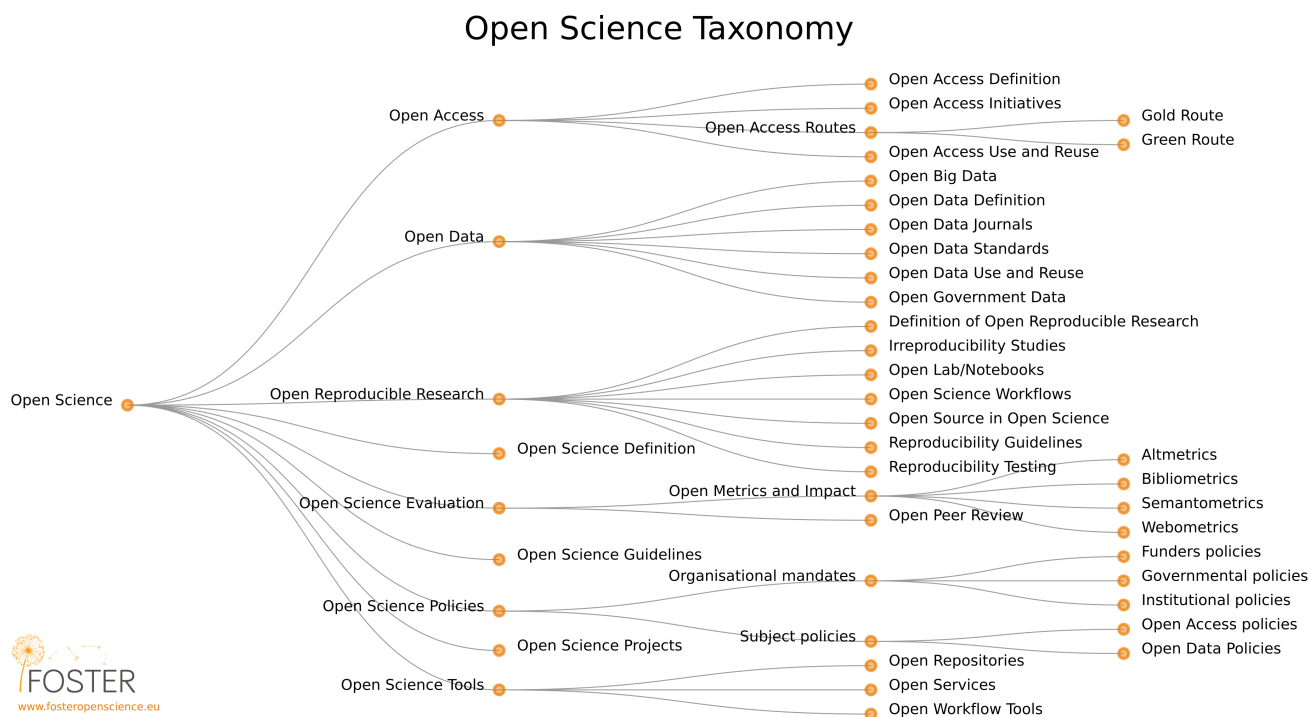


Figure 1: The FOSTER Open Science Taxonomy [5]

Horizon 2020²,³ a worldwide call for new projects, in the UK National Health Service (NHS)⁴, and in the one of the largest Brazilian research funding agency FAPESP⁵.

Considering the aforementioned scientific and professional benefits, we wondered the degree of knowledge of OS from researchers acting as supervisors of Master's degree students and Ph.D. candidates of the State University of Maringá (UEM), a Brazilian university. To do so, we surveyed 90 researchers from different research centers, named: Technology Center (CTC), Center for Human Sciences, Letters and Arts (CCH), Health Sciences Center (CCS), Center of Agrarian Sciences (CCA), Biological Sciences Center (CCB), Center for Applied Social Sciences (CSA), Exact Sciences Center (CCE), and institution external collaborators. The university has 59 undergraduate courses with more than 18,000 enrolled students, 16 specialization/MBA courses with 3,700 students, and 54 graduate programs with more than 4,700 students (Master's and Ph.D.).

This paper is organized as follows: Section 2 presents the methodology adopted for this study; Section 3 presents the obtained results; Section 4 discusses the results; Section 5 provides an action plan based on the obtained results; and Section 6 presents final remarks and directions for future work.

2 RESEARCH METHODOLOGY

This section presents information about the survey carried out, in terms of methodology. We structured the survey according to the guidelines by Linäker et al. [1]. The information is organized into subsections as follows.

2.1 Goal and Research questions

This study **aims to** understand the knowledge degree on Open Science, **with the purpose of** characterizing Open Science practices, **with respect to** research activities openness, **from the point of view of** researchers of all scientific areas, **in the context of** lecturers who supervise Master's students and Ph.D. candidates at UEM.

Therefore, the main research question that guided this study was: ***“What is the Open Science degree of knowledge that graduate supervisors have in the university?”***.

To aid answering this question, we defined the following secondary research questions (SRQ):

- **SRQ1:** What is the general awareness of OS practices by the researchers at the university?
- **SRQ2:** How do researchers understand the openness of their research activities at the university?
- **SRQ3:** What are the OS barriers researchers mention to be overcome at the university?
- **SRQ4:** Do the researchers practice any of the OS principles at the university?

²<https://openscience.eu/Open-Science-in-Horizon-Europe>

³<https://www.fosteropenscience.eu/content/winning-horizon-2020-open-science>

⁴<https://digital.nhs.uk/services/supporting-open-data-and-transparency>

⁵<https://www.fapesp.br/openscience/en>

- **SRQ5:** Do the researchers put any effort at following OS principles at the university?
- **SRQ6:** Do the researchers adopt OS practices at the university?
- **SRQ7:** Does the university provide any support to researchers put OS in practice?

2.2 Target Audience and Population

This study took into consideration graduate lecturers at UEM, who supervise Master's students or Ph.D. candidates, enrolled in any of the university programs, as the target audience. No prior knowledge on Open Science was required.

2.3 Sampling

We sent the invitation to our survey via e-mail for 892 researchers. We had all the research centers represented in this research by answers from each of them. We, therefore, had 90 valid answers.

Figure 2 depicts the number of participant answers per research center (Question Q1).

2.4 Instrument and Evaluation

We adopted a web-based questionnaire⁶ for this survey, with 36 questions about OS. We built this instrument with Google Forms, thus we sent participants the access link by email.

During the instrument development we sought to estimate the response time of the questions. Therefore, we took into account the distribution of questions to avoid fatigue bias. At the end of the instrument development, we envisioned an average time of 15 minutes to answer all the questions.

We evaluated the instrument with a pilot project with 10 researchers, who were not in the participants set. At the end, no changes were suggested. Thus, we kept the instrument as is before the pilot project.

We presented the questions of the instrument in different formats, such as multiple choice, selection box, open box, multiple choice and dichotomous grid. To facilitate interpretation, we prepared the questions in a simple language, with short statements.

2.5 Data Sharing

Data of this work is available at <https://doi.org/10.5281/zenodo.6977073> in CSV format.

3 RESULTS

This section presents a summary of the responses obtained from the survey.

3.1 General Awareness

Most of the researchers have heard (question Q2) about Open Science (59 - 65.56%).

We asked researchers what OS practices they know or use (question Q3). Table 1 shows that most of them know/use the following practices: open access (49 - 30.25%), open data (33 - 20.37%), and open science tools (21 - 12.96%). Note that 28 (17.28%) researchers do not know/use any OS practices.

Table 1: Answers to Q3

Practices	Count	%
Open Access	49	30.25%
Open Data	33	20.37%
Open Science Tools	21	12.96%
Open Reproducible Research	14	8.64%
Open Science Evaluation	11	6.79%
Open Science Policies	6	3.70%
None of them	28	17.28%
Total	162	100.00%

With regard to their own assessment of open science knowledge (question Q4 - Table 2), the majority of them answered that they are aware of it, but never used any practices (31 - 34.44%), have some experience (29 - 32.22%), and are unaware of it (29 - 32.22%). Only one researcher claims having an extensive experience with OS.

When researchers were asked to summarize their OS view (question Q20 - Table 3), they mainly answered that: OS is an opportunity for science with more benefits than drawbacks (35 - 36.46%); OS is mainly positive for science with benefits and disadvantages (28 - 29.17%); and OS is an excellent opportunity for science (17 - 17.71%). On the other hand, two (2.08%) researchers claimed OS is a new worrying perspective for science and one (1.04%) he/she needs better understanding and discussion to provide an opinion on it. Thirteen (13.54%) of them do not have an opinion on it so far.

Regarding question Q21, when asking researchers about the possibility to adopt OS practices in their research, 18 (20.00%) could not say they would do it or not, 63 (70.00%) would do it, and nine (10.00%) of them would not.

3.2 Research Openness

By analyzing Table 4 related to question Q5, we can observe 49 (25.79%) researchers understand that Open Science should be open to all citizens, whereas 35 (18.42%) cite it should be open to scientists for the same area/discipline and 33 (17.37%) for other disciplines. Other 25 (13.16%) researchers find OS should be open to interested groups, 18 (9.47%) to civil and social organizations, 18 (9.47%) to funders and policy makers, and 12 (6.32%) to industry and companies.

In questions Q9.1 through Q9.7 we asked researchers specific reasons for them finding OS to be open (Figure 3) in terms of the following factors diversity, efficiency, equity, ethics, justice, impact, and rigor, summarizes the researcher's answers.

As one can observe in Figure 3, related to questions Q9.1 through Q9.7, most of researchers find diversity, efficiency, equity, ethics, justice, impact, and rigor **the most important reason** for OS to be open, **especially for efficiency**, which is focused on sharing data, procedures and/or science optimization. However, **diversity** is the less rated most important reason, which deals with the incorporation of under-represented groups in science (e.g. sex, races, cultures). Most of researchers practically **evenly understand all these factors are important reasons** for OS to be open, ranging from 32 answers to efficiency to 44 to equity, which is focused on allowing access to all scientific such as results, methods, and software.

⁶Questions available at <https://doi.org/10.5281/zenodo.6977073>

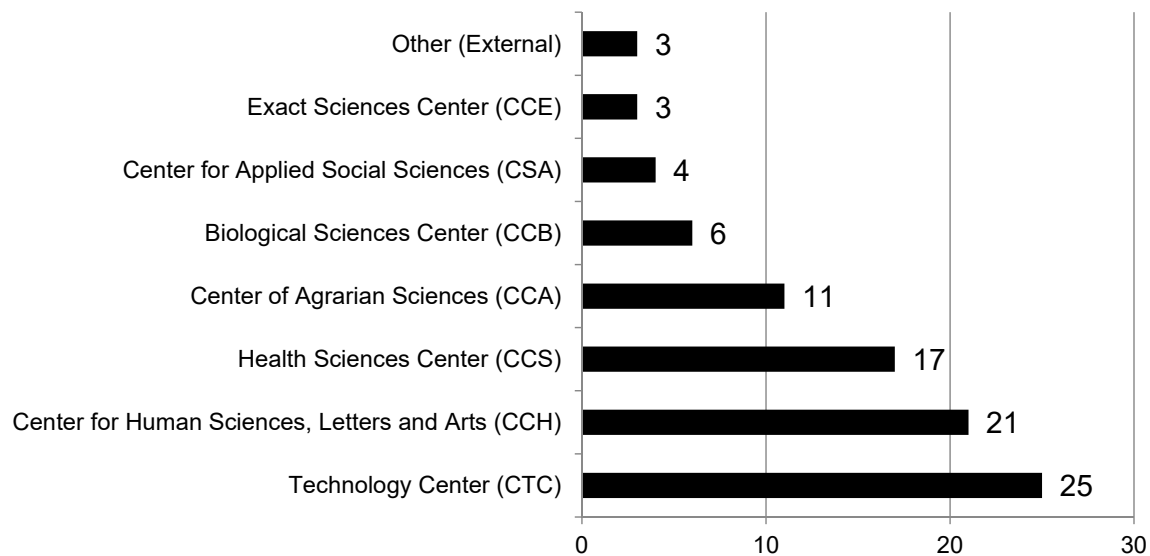


Figure 2: Total answers per university research center

Table 2: Answers to Q4

Experience with Open Science	Count	%
I am aware of Open Science, but I have never used practices in my research	31	34.44%
I have some experience with Open Science practices	29	32.22%
Until now, I was unaware of Open Science practices	29	32.22%
I have extensive experience with Open Science practices	1	1.11%
Total	90	100.00%

Table 3: Answers to Q20

	Count	%
Open Science is an opportunity for Science, with the benefits outweighing the disadvantages	35	36.46%
Open Science is mainly positive for science, it has benefits, but also important disadvantages	28	29.17%
Open Science is an excellent opportunity for Science, mainly with benefits	17	17.71%
I have no formed opinion	13	13.54%
Open Science is a new worrying perspective for science	2	2.08%
It needs to be better understood and discussed	1	1.04%
Open Science is an unimportant bureaucratic burden for Science	0	0.0%
Open Science is a real threat to science	0	0.0%
Total	96	100.00%

A relatively important reason was chosen by practically the same number of researchers, varying from 7 to efficiency to 15 to impact, which deals with overcoming traditional metrics for scientific impact. A few researchers find these factors are not a reason for OS to be open, except for diversity with 16 answers, which is unbalanced compared to the remaining answers varying from 2 to 6. A relatively significant part of the researchers does not know or does not have an opinion on these factors to influence OS to be open.

In questions Q10.1 through Q10.7 we asked researchers reasons against OS (Figure 4) based on the following claims: not a priority now, lack of public understand, public is not ready yet, low quality, potential danger of misuse, lack of incentives, and injustice.

Based on Figure 4, one can straightforwardly observe that the most rated answer is about none of these claims to be a reason against OS. However, one can also notice that 9 to 28 researchers find such claims a relatively important reason against OS, especially for its potential danger of misuse, lack of incentives, injustice, and

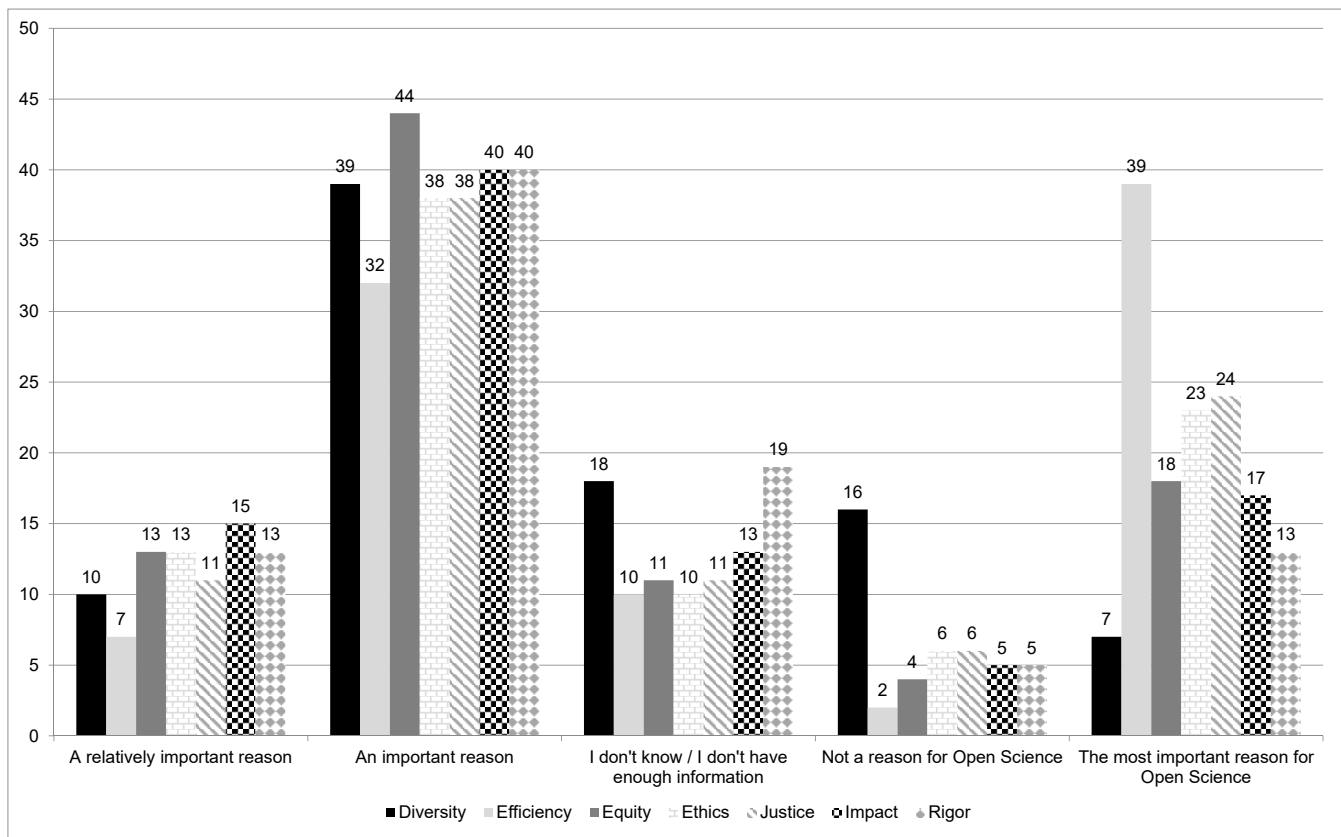


Figure 3: Open Science in the perspective of diversity, efficiency, equity, ethics, justice, impact, and rigor

Table 4: Answers to Q5

Answer	Count	%
Open to all citizens	49	25.79%
Open to scientists in the same area/discipline	35	18.42%
Open to scientists from other disciplines	33	17.37%
Open to especially interested groups	25	13.16%
Open to civil and social organizations	18	9.47%
Open to funders and policy makers	18	9.47%
Open to industry and companies	12	6.32%
Total	190	100.00%

research low quality. In addition, four to 24 researchers find these claims an important reason against OS, especially for potential danger of misuse, lack of public understand, and injustice. Few of the researchers understand such claims are the most important reason against OS as, for instance, research low quality. A significant part of the researchers either do not know nor have an opinion against OS.

Question Q18 is regarding the researcher's opinion on sharing/reusing data for everyone to use and publish, without restrictions on copyright and patents or other control mechanism. As this is an open-ended question, we need to curate it, thus we derived four categories: **Nothing to declare**, **There must be restrictions**,

I agree and **I agree with restrictions**. Seven researchers (7.78%) had nothing to declare. Another 14 (15.56%) do not agree and find there should be restrictions, whereas 31 (34.44%) agree with sharing and/or reuse without any kind of copyright or control mechanisms. The remaining 38 (42.22%) agree, but with some kind of restriction, such as the obligation to cite the author(s).

3.3 Barriers

When analyzing Question Q6 we observe that 69 researchers (76.67%) did not find any barriers related to the concept of OS in their daily work. Another 21 researchers (23.33%) reported they encountered one or more barriers such as those mentioned in the following items: tools without user guide; broken links for article access; obtaining databases created by other researchers; difficulty at reproducing data, algorithms and other research artifacts; lack of resources to acquire software licenses; access to articles published in databases not paid by the university; data on the methodology for reproducing analytical methods; data and reuse of codes and/or parameters; difficulties in obtaining authorization for the dissemination of drawings and diagrams; and lack of access to microdata and article scripts.

Table 5 summarizes answers for Question Q11. We can observe that 53 researchers find the lack of adequate infrastructure could be the most important barrier. Another 44 researchers understand that funding constraints might be the most important barrier. In

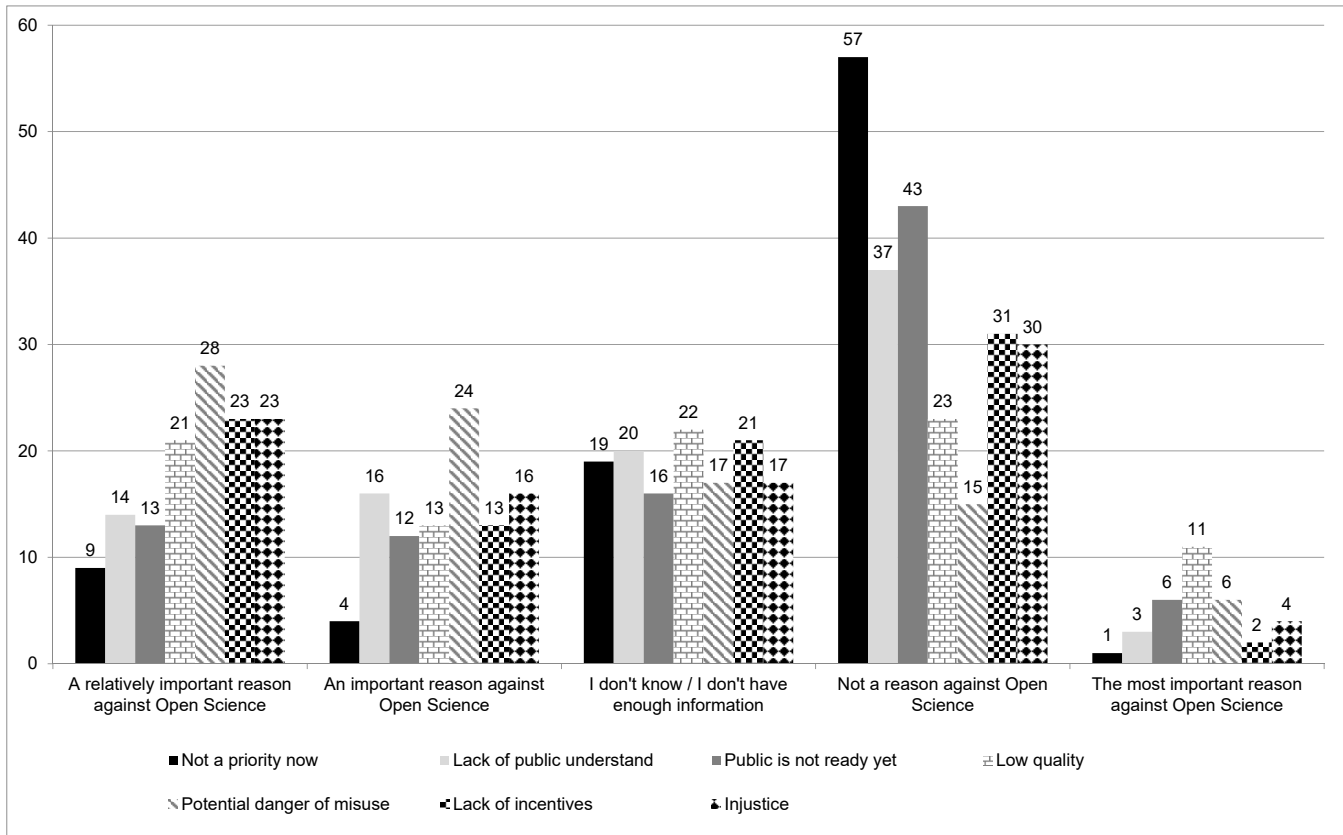


Figure 4: Reasons against Open Science

addition, 40 researchers find that the lack of clear steps to follow an OS initiative could be the most important barrier.

Table 5: Answers to Q11

Barriers	Count	%
Adequate lack of infrastructure	53	39.85%
Financing restriction	44	33.08%
Lack of clear steps to follow	40	30.08%
Time constraints	25	18.80%
Fears and uncertainties for development	22	16.54%
I have no opinion	2	1.50%
Total	133	100.00%

3.4 Practice of Open Science

At analyzing the answers to Question Q12 we can observe 81 researchers (90%) claim they never participated or performed any activity or action related to OS, whereas only nine (10%) did it. Among the main activities mentioned are: provisioning of experimental package; publication of articles with open access; provisioning of a reference database; and sampling data. Note that such researchers reported activities or actions may involve one or more OS practices.

Question Q17 addressed licensing of research artifacts, which allows the reuse and sharing of processes, artifacts and results

obtained. To this question, 54 researchers answered they had already used any of the licenses listed in Table 6, whereas 36 did not. One can observe in such table that the most used license is the Creative Commons CC0, which allows sharing contents globally without restrictions.

3.5 Effort

In question Q8, we asked researchers about the effort they might applied to share/reuse their research artifacts and results. As it is an open-ended question we had to curate it. Therefore, we categorized the answers into **I cannot say**, **None Effort**, **Some Effort** and **Much Effort**. Then, most of the researchers (30 - 33.33%) performed some effort, whereas 25 (27.78%) did not put any effort on this. A relatively significant part of the researchers (19 - 27.11%) could not precise such effort, and 16 (17.78%) put much effort.

3.6 Adoption

We asked researchers whether they could adopt OS practices in their daily research. We found out that 63 (70.0%) would adopt practices involving OS, whereas 18 (20.0%) do not know whether to adopt or not OS. A small part (0 - 10.0%) of the researchers affirm they would not adopt the practices.

Table 6: Answers to Q17

	Count	%
CC0 (Releases content globally without restrictions)	28	51.85%
BY (Attribution)	9	16.67%
BY-SA (Attribution + Equal Shares)	1	1.85%
BY-NC (Attribution + Non-Commercial)	5	9.26%
BY-ND (Attribution + No Derivations)	3	5.56%
BY-NC-SA (Attribution + Non-Commercial + Equal Shares)	6	11.11%
BY-NC-ND (Attribution + Non-Commercial + No Derivations)	2	3.70%
Total	54	100.00%

3.7 Support for OS

Regarding question Q7, we asked researchers whether they have used any tool that supports OS. The majority of them (78 - 86.67%) said they have not used any, whereas 12 (13.33%) of them have used some, such as, the following mentioned: Redalyc; PubMed, PLoS, SciELO and ResearchGate; Scilab (<https://www.scilab.org>); Zenodo (www.zenodo.org); and NCBI-Blast (<https://blast.ncbi.nlm.nih.gov/Blast.cgi>).

In question Q13 we asked researchers whether they received any training on OS from the university. The majority 88 (97.78%) claimed they did not receive any training on OS, whereas only two (2.22%) of them received any training. The aforementioned training is most related to research integrity events and access to digital platforms for scientific publications.

We also asked researchers whether they received any incentive from the university related to OS (Question Q14 - Table 7), such as, written guidelines (web page, brochure, videos), policies, or recommendations. Most of them (43 - 47.77%) claimed they would like to receive more incentive or sufficient support for OS practices. A significant part (41 - 45.55%) of researchers neither know about nor have enough information of such OS incentive. Only a small group of six (6.66%) researchers said this incentive is not relevant to their personal work. Note that none of them have received any incentive from the university.

In question Q15 (Table 8) we asked researchers whether they would like to receive any incentive for OS practices in terms of technical infrastructure (models, software, storage, databases, publication and/or data repositories). Most of them (50 - 55.56%) would like to receive more of this kind of incentive, whereas 38 (42.22%) do not have enough information on it. Only two (2.22%) said this type of incentive is not relevant for their work. Note that none of them received any support of this kind from the university.

In question Q16 we asked about the university support for OS in terms of three dimensions: specialized support (e.g. experts on different aspects of OS, research data committees, training, workshops), financial support and rewards, and career prospects and recognition. Figure 5 summarizes the researchers answers.

Most of the researchers (47 - 52.22%) claimed they would like to receive from the university **more specialized support**, whereas 40 (44.44%) do not have enough information on it. Note that only three (3.33%) said specialized support is not relevant for their work.

Forty-four (48.88%) researchers said they would like to receive from the university certain **financial support and rewards** for

OS practices, whereas the same number do not have enough information on it. Note that only two (2.22%) said this kind of support is not relevant for their work.

In the **career prospects and recognition**, 41 (45.55%) researchers would like to benefit from more university support to this dimension, whereas 46 (51.11%) do not have enough information on it. Note that only three (3.33%) said this kind of support is not relevant for their work.

Note that none of the researchers received any support for these three dimensions.

In question Q19 we asked the researchers their opinion on data repositories. We curated this open-ended question, thus deriving the following categories: **I do not use them**, **Nothing to declare**, **It does not meet my research needs**, and **It does meet my research needs**. Most of them 42 (42.22%) claimed data repositories meet their research needs, whereas 18 (20.0%) had nothing to declare. Sixteen (17.79%) researchers said that the repositories do not meet their research needs, and 14 (15.55%) do not use any type of repository.

4 DISCUSSION OF RESULTS

In this section we discuss the results in terms of the secondary research questions of this study (Section 2.1).

With regard to the **general awareness of OS (SRQ1)**, most of the researchers have heard about it. As we expected, common and well-known practices are performed by some of the researchers in terms of open access, open data, and open science tools (articles publishing platforms).

We did not expect that almost 20% of the researchers do not know or never performed any OS practices based on the OS worldwide importance and positive impact on science. We understand this might be related to the low OS knowledge level claimed by around 31% of the researchers, or to the total unawareness of OS by almost 32% of them. To shed a light to this matter, one researcher is very experienced in OS practices, which might motivate spreading the word on OS in the university.

Two researchers have claimed OS is a worrying perspective of science and almost 15% have no saying on this. We understand that the low OS knowledge or the lack of practice on OS might led these researchers to fear OS practices. In addition, we understand that with a well-quality training on OS principles and practices might provide a glimpse on the benefits and takeaways for their research openness.

Table 7: Answers to Q14

Written guidelines: (web page / brochure / videos), policies, recommendations	Count	%
I would like to receive more incentive or sufficient support	43	47.78%
I don't know about it / I don't have enough information	41	45.56%
This type of support is not relevant or specific to my personal work	6	6.67%
I received adequate support or incentives from my institution	0	0.00%
Total	90	100.00%

Table 8: Answers to Q15

Technical infrastructure: (models, software, storage, databases, publication and/or data repositories)	Count	%
I would like to receive more incentive or sufficient support	50	55.56%
I don't know about it / I don't have enough information	38	42.22%
This type of support is not relevant or specific to my personal work	2	2.22%
I received adequate support or incentives from my institution	0	0.00%
Total	90	100.00%

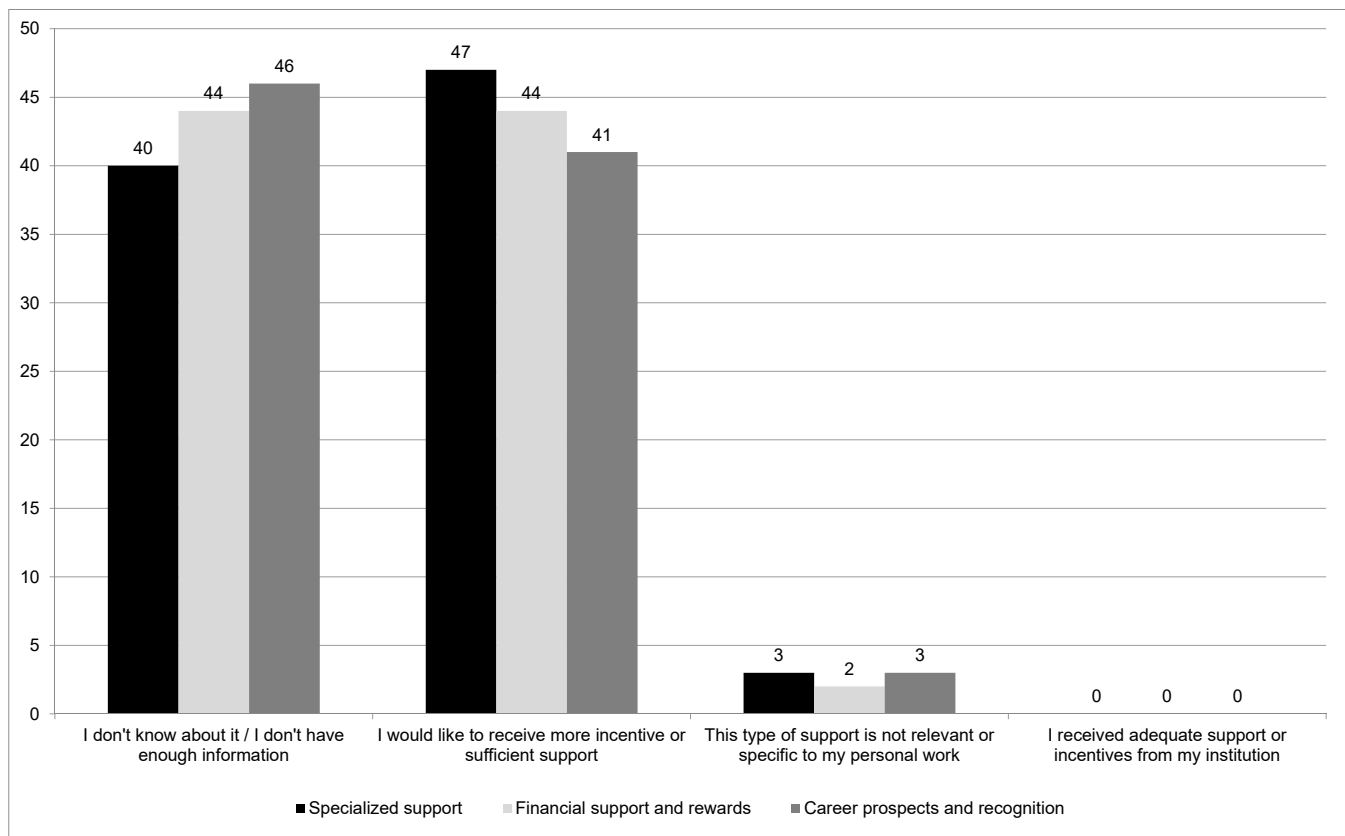


Figure 5: Incentives from the university: specialized support, financial support and rewards, and career prospects and recognition

We expected a high number of researchers willing to adopt OS. However, 10% claimed they would not adopt it and almost 20% do not know. As already mentioned, low OS knowledge might have

influenced these answers, therefore a proper training and incentives to OS from the university might decrease such numbers.

Answering SRQ1: Particular OS activities are performed by most of researchers. However, low knowledge rates on OS practices

by the researchers might jeopardize exploiting OS benefits towards making science available to all citizens. *Proper OS training/education and incentives should be a paramount on the university goals.*

By discussing **SRQ2**, most of the researchers believe OS should be open to all citizens, which we already expected due to the goals of the OS movement and the relatively high rate on OS knowledge. Around 60% of the researchers claim OS should be open to scientists for the same area/discipline, other disciplines or to interested groups, whereas only around 10% is concerned with the OS openness to civil and social organizations. This fact concerns us as most of the research funding in Brazil come from public agencies, such as, CAPES and CNPq. Therefore, making research available only for the researchers peers might be a drawback for science evolution.

In another perspective, researchers find efficiency, equity, ethics, justice, impact, and rigor the most important reasons for OS to be open. Although we already expected efficiency should be a strong reason, a significant part of the researchers understand that diversity is not a reason for the openness of OS. This is concerning as there are thousands of researches on diversity for incorporating under-represented groups in science, for instance, the Internal Science Council Gender initiative⁷, inclusiveness and diversity in citizen science discussed by Paleco et al. [4], and the Embracing Diversity⁸ initiative from UNESCO.

On the other hand, we asked researchers about reasons against OS in terms of: OS is not a priority now, lack of public understand, public is not ready yet, low quality, potential danger of misuse, lack of incentives, and injustice. Most of the researchers find these are not reasons against OS. However, certain researchers find potential danger of OS misuse, lack of incentives, and injustice proper reasons against OS practices. Such reasons might be overcome by adopting clear and responsible OS policies by the university within a potential OS initiative. Once again, we understand OS education is the key to succeed. In addition, low quality of research seems to concern certain researchers as the most important reason against OS. As research quality is a relative attribute, depending of the definition of research quality, this factor seems to be out of control, as anyone could share whatever his/her research produces. We understand that clear university OS policies/program should explicitly define and advise on research quality with, for instance, guidelines and/or heuristics.

For the data sharing/reusing sake, as we expected, most of the researchers agree with it with none or some kind of restrictions (e.g. citing the research artifact author or the license used).

Answering SRQ2: The researchers are willing with the OS openness, but with specific concerns, especially on the shared/reused research artifacts misuse. *Such concerns might be dissipated with a strong OS education program in the university.*

In **SRQ3** we presented results on possible barriers for OS. Almost a quarter of the researchers claimed any barrier to OS practices in their researches, mainly for reproducing research data and algorithms, access to published articles, the methodology applied, and data reuse. The main principles of OS, such as, data provenance,

data preservation, and data management plans might conduct researchers to overcome such barriers for their own researches, thus promoting and motivating colleagues to follow such principles.

In addition, most of the researchers agree that in case the university implements an OS program, the concerning should be at an adequate infrastructure. Funding constraints and the lack of clear steps to follow an OS initiative also might be an important barrier. To overcome such barriers, the university really needs to invest in an appropriate OS program, with the aid of the funding agencies of Brazil. The problem here is that certain funding agencies, especially the state one, is neither aware of nor have discussed the OS movement yet.

Answering SRQ3: The researchers claimed certain concerning barriers for OS practices in the university. *Therefore, we understand the university should play a central role in gathering up OS promotion funding from the national and state funding agencies towards establishing an OS initiative for our researchers, providing proper training and infrastructure.*

In the perspective of experience in practicing OS (**SRQ4**), what we most concern us is that 90% of the researchers have not participated in any of OS activities or actions. This is a higher number if we take into consideration the worldwide initiatives and importance of the subject. A reduced number of researchers already have provided the research experimental package, published articles as open access, or provided a database/dataset properly. This is especially concerning as the university has many well-known researchers enrolled in its graduate programs, in practically all areas of science.

Another aspect that has concerned us in this study is the fact that only one third of the researchers have used any artifacts sharing licenses, such as, those from Common Creative ones. At using such licenses, most of the researchers choose the less restricted one, the CC0, which is very interesting as no restrictions are applied to such a content.

Answering SRQ4: A few researchers have experience in OS practices and those who have are mainly for sharing experimental package (we supposed in an ad hoc fashion) and publishing articles as open access (maybe paying for it). In addition, researchers have few used licenses to share their research artifacts. *Therefore, we understand the university should work towards actions to increase the researchers experience on OS.*

By answering **SRQ5**, we did not expect that only one third of the researchers put some effort at sharing/reusing their research artifacts and results and around one fourth did not put any effort.

Answering SRQ5: A small part of the researchers put some effort at practicing OS, such as, reusing or sharing research artifacts. *Training on the benefits and providing incentives to researchers on practicing OS seems to be the right way.*

In the results of **SRQ6** we could see that most of the researchers are willing to adopt OS practices in their research activities. On the other hand, only a small group claimed they would not adopt them.

Answering SRQ6: Most of the researchers are willing to adopt OS practices. *Therefore, an OS institutional program should provide them theoretical and practice to support OS adoption in the university.*

Regarding the results of **SRQ7** we could see that the majority of the researchers never used any tool with support to OS. Also, such researchers never received any training on OS by the university. A significant part of the researchers would like to receive any kind

⁷<https://council.science/current/press/gender-equality-science-global>

⁸<https://unesdoc.unesco.org/ark:/48223/pf0000137522>

of incentive from the university, such as, written guidelines (web page, brochure, videos), policies, or recommendations. In addition, they also would like to receive technical incentives, such as, models, software, storage, databases, publication and/or data repositories. We also could see that most of them would like to receive support for OS by the university, such as, specialized support, financial support and rewards, and career prospects and recognition. Researchers also provided their opinion on the importance of data repositories. Most of them claimed in favor of data repositories as they meet their research needs.

Answering SRQ7: Researchers never used OS supporting tools. They are willing to receive training and (theoretical and technical) incentives by the university. They find such support important to their career prospects and recognition. *Therefore, an intensive and well-organized OS program at the university led by the research and post-graduation sector will be of great value and appreciated by the researchers.*

5 PROSPECTIVE ACTIONS

In view of the results obtained with this study, we envision the following prospective actions:

- replication of this survey in the same university with different researchers aiming at confirming the results;
- replication of this survey in other Brazilian universities aiming at perceiving the OS knowledge degree, thus comparing to this study results;
- replication of this survey in European and North American universities aiming at perceiving the OS knowledge degree, thus also comparing to this study results; and
- starting discussing an action plan to establish an OS program at the university taking into account different sectors, thus motivating the university staff to implement OS practices and researchers to adopt them.

6 FINAL REMARKS

We presented in this paper a survey on the degree knowledge of researchers from UEM, based on seven research questions.

In general, we perceived that the researchers know OS and they are willing to agree to its practices, but there is no support from the university. Researchers believe these practices might be important to their careers, thus making their research according to the worldwide OS movement.

We understand that a proper OS program in the university will be supported by most of its researchers. Such a program should have at least two pillars: one aiming at OS education for researchers and students, and one for infrastructure, including organizational and technical activities.

ACKNOWLEDGMENTS

We would like to enormously thank all researchers from the State University of Maringá (UEM) who took this survey.

REFERENCES

- [1] Johan Linåker, Sardar Sulaman, Martin Höst, and Rafael de Mello. 2015. *Guidelines for Conducting Surveys in Software Engineering*. Technical Report 1.1. Lund University, Sweden.
- [2] Erin C McKiernan, Philip E Bourne, C Titus Brown, Stuart Buck, Amye Kenall, Jennifer Lin, Damon McDougall, Brian A Nosek, Karthik Ram, Courtney K Soderberg, et al. 2016. How open science helps researchers succeed. *eLife* 5 (2016), e16800. <https://doi.org/10.7554/elife.16800>
- [3] Daniel Mendez, Daniel Graziotin, Stefan Wagner, and Heidi Seibold. 2020. Open Science in Software Engineering. In *Contemporary Empirical Methods in Software Engineering*. Springer, 477–501.
- [4] Carole Paleco, Sabina García Peter, Nora Salas Seoane, Julia Kaufmann, and Panagioti Argyri. 2021. *Inclusiveness and Diversity in Citizen Science*. Springer International Publishing, 261–281. https://doi.org/10.1007/978-3-030-58278-4_14
- [5] Open Science Policies. 2020. The future of science is open. <https://www.fosteropenscience.eu/taxonomy/term/8>
- [6] Daniel Schlagwein, Kieran Conboy, Joseph Feller, Jan Marco Leimeister, and Lorraine Morgan. 2017. “Openness” with and without Information Technology: A Framework and a Brief History. *Journal of Information Technology* 32, 4 (2017), 297–305. <https://doi.org/10.1057/s41265-017-0049-3>
- [7] UNESCO. 2019. UNESCO Recommendation on Open Science. <https://unesdoc.unesco.org/ark:/48223/pf0000378841>
- [8] Chris Woolston. 2021. Impact factor abandoned by Dutch university in hiring and promotion decisions. *Nature* 595, 462 (2021). <https://doi.org/10.1038/d41586-021-01759-5>