Introducing Open Science in Teaching Health Economic Modelling – Supplementary Material

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Supplementary Material 1: Changes in comparison with proposal

The proposal of this project has been published elsewhere [1]. Originally, we did not intend to formally include an assessment of Open Science within the grading of the course. When designing the teaching innovation, we decided to include a graded reflection on Open Science within health economic modelling to foster participants' engagement during the Open Science activities and to encourage them to apply these Open Science practices within their project.

Another change we made to the project proposal is that we asked participants to present the design of a public outreach activity instead of presenting how they included Open Science practices in their project. This change was made to avoid overlap between what the different student pairs would present and thus ensure diversity between the presentations.

Due to time constraints, we were not able to perform the "key terms" game to introduce the discussion on Open Science in Health Economics and Outcomes Research.

Finally, we were not able to recruit students' assistants to co-design the teaching activities.

[1] Pouwels X. Towards open science within health care technology and management education. Research Ideas and Outcomes 2022;8:e97853. https://doi.org/10.3897/rio.8.e97853.

Supplementary Material 2A: survey for HEOR professionals and previous healthcare technology and management students

Introduction

Dear colleague,

You have received an invitation to participate in this survey because you are active within the field of health economics and outcomes research (HEOR). Thank you in advance for taking the time to answer this survey.
As part of the Comenius Teaching Fellow project “Towards Open Science within the Health Care Technology and Management Education”, we aim to introduce Open Science principles and practices to students following the “Advanced Simulation for Health Economic Analysis” course of the Health Care Technology and Management Master specialisation from the Industrial Engineering & Management Master program at the University of Twente.
During this course, students have to develop a discrete event simulation using the open-source software ‘R’ to assess the cost-effectiveness of new biomarkers to inform treatment decision of cancer versus care as usual. This provides the perfect opportunity to apply Open Science principles, such as ensuring the transparency and reproducibility of their script and analyses.
To match the content of the Open Science activities to the needs of professionals active in the HEOR field, this questionnaire asks your opinion on the knowledge and practical skills relating to Open Science that future professionals active in your sector should develop during their academic curriculum.
Filling in this questionnaire will take approximately 5 minutes. The aggregated results of this survey will be published as a scientific journal article or report. Your answer will be treated anonymously and stored in an open registry for re-use (opt-out option available).

Best wishes,
Xavier Pouwels, on behalf of the research team.

Consent

◯ By ticking this box, you agree with the publication of the aggregated results of this survey as a scientific journal article (or report) and with the anonymous storage of your answers in an open registry. You further confirm that you have understood the aim of the project and this questionnaire.

◯ By ticking this box, you agree with the publication of the aggregated results of this survey as a scientific journal article (or report) but you do not provide consent for the anonymous storage of your answers in an open registry. You further confirm that you have understood the aim of the project and this questionnaire.

Open Science definition

In this survey, Open Science is defined as follows:
“[O]pen science is defined as an inclusive construct that combines various movements and practices aiming to make multilingual scientific knowledge openly available, accessible and reusable for everyone, to increase scientific collaborations and sharing of information for the benefits of science and society, and to open the processes of scientific knowledge creation, evaluation and communication to societal actors beyond the traditional scientific community. It comprises all scientific disciplines and aspects of scholarly practices, including basic and applied sciences, natural and social sciences and the humanities, and it builds on the following key pillars: open scientific knowledge, open science infrastructures, science communication, open engagement of societal actors and open dialogue with other knowledge systems.”

Source: UNESCO Recommendations on Open Science (https://unesdoc.unesco.org/ark:/48223/pf0000379949.locale=en)

Hence, this project focusses on teaching hands-on skills to make one's analysis more transparent, reproducible, and accessible. Additionally, we will focus on teaching (dis)advantages of making one's analysis more open.

General information

How is your current work environment best described?

◯ Academia
◯ Government
◯ Industry
◯ Consultancy

- ○ Non-governmental organisation
- ○ Other: [ ]

Your professional career is currently

- ○ Shorter than 2 years
- ○ Between 2-5 years
- ○ Between 5-10 years
- ○ Between 10-20 years
- ○ More than 20 years

Do you **develop** simulation models in your daily work activities?

- ○ Yes
- ○ No

Do you **review** simulation models in your daily work activities?

- ○ Yes
- ○ No

Relevant Open Science skills

How important are the following Open Science skills to perform your daily work activities?

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
1. Being able to use a script-based statistical software, e.g. R, Python, …	○	○	○	○	○
2. Pre-registering your work	○	○	○	○	○
3. Writing a data and / or software management plan	○	○	○	○	○

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
4. Version controlling (script, software, …)	○	○	○	○	○
5. Code / script annotation and documentation	○	○	○	○	○
6. Licensing software code	○	○	○	○	○
7. Collaborative (software) script development	○	○	○	○	○
8. Identifying and reusing open data	○	○	○	○	○
9. Creating reproducible reports, e.g. using Markdown or Jupiter notebook	○	○	○	○	○
10. Creating interactive applications, e.g., R-Shiny	○	○	○	○	○
11. Collaborative writing	○	○	○	○	○
12. Sharing software code	○	○	○	○	○
13. Sharing data	○	○	○	○	○
14. Communicating your work to a lay audience	○	○	○	○	○
15. Communicating your work through social media	○	○	○	○	○
16. Critically review someone else's work and share the review openly	○	○	○	○	○
17. Archiving your work in an open online repository	○	○	○	○	○
18. Adhering to the Findable, Accessible, Interoperable, Reusable (FAIR) principles	○	○	○	○	○
19. Publishing open access	○	○	○	○	○

	Not at all important	Slightly important	Moderately important	Very important	Extremely important
20. Identifying Fake news	○	○	○	○	○

Are there other skills relating to making your work more open which should be taught during one's academic curriculum and are not in the previous list?

Block 4

Please provide any feedback on this survey or thought concerning Open Science in education which you would like to share with us.

Please leave your email address if you would like to participate in an interview or focus group on the role of Open Science in education and how to integrate the skills mentioned in the previous questions in education.

Supplementary Material 2B: survey for participants in the teaching innovation before the teaching innovation. The survey provided after the teaching innovation was similar to this one with additional evaluation questions on the teaching innovation.

Introduction

Dear student participating in the “Advanced Simulation for Health Economic Analysis” course,

As part of the Comenius Teaching Fellow project “Towards Open Science within the Health Care Technology and Management Education”, we aim to introduce Open Science principles and practices to you during this course. For the final assignment of this course, you have to develop a simulation model, which provides a good opportunity to apply Open Science principles and practices.
To match the content of the Open Science activities to your needs and to evaluate the effectiveness of this teaching innovation, this survey asks about your attitudes towards Science and your proficiency concerning Open Science-related skills.
Filling in this questionnaire will take approximately 10 minutes. The aggregated results of this survey will be published as a scientific journal article or report. Your answer will be treated anonymously and stored in an open registry for re-use (opt-out option available below).
If you wish to withdraw your consent concerning the use or publication of your data during the course of this teaching innovation. Please send me an email at x.g.l.v.pouwels@utwente.nl or ask me directly.

Best wishes,
Xavier Pouwels, on behalf of the research team.

Consent

◯ By ticking this box, you agree with the publication of the aggregated results of this survey as a scientific journal article (or report) and with the anonymous storage of your answers in an open registry. You further confirm that you have understood the aim of the project and this questionnaire.

◯ By ticking this box, you agree with the publication of the aggregated results of this survey as a scientific journal article (or report) but you do NOT provide consent for the anonymous storage of your answers in an open registry. You further confirm that you have understood the aim of the project and this questionnaire.

General information

I would like to work in the following environment after graduating:

- ○ Academia
- ○ Governmental organisation
- ○ Industry
- ○ Consultancy
- ○ Non-governmental organisation
- ○ Other: _____

Attitudes towards Science

Please indicate whether you (dis)agree with the following statements

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
I trust the results described in scientific journal articles	○	○	○	○	○
All scientific knowledge is produced according to an open and transparent process	○	○	○	○	○
Studies contesting the research hypothesis (negative results) are published as often as studies confirming the research hypothesis	○	○	○	○	○
When a health economic evaluation complies to reporting guidelines, it means that it is highly reproducible	○	○	○	○	○
Researchers are rewarded for performing	○	○	○	○	○

	Strongly disagree	Somewhat disagree	Neither agree nor disagree	Somewhat agree	Strongly agree
transparent and reproducible research					
Open-source publishing of health economic evaluations is common practice	○	○	○	○	○
Industry-sponsorship influences the results of health economic evaluations	○	○	○	○	○

To your opinion, how often do researcher:

	Never	Sometimes	About half the time	Most of the time	Always
Pre-register research hypothesis and analysis plan before performing the research in question	○	○	○	○	○
Share data openly	○	○	○	○	○
Share software code used for data analysis	○	○	○	○	○
Take measure to ensure the reproducibility of their research	○	○	○	○	○
Involve stakeholders in scientific knowledge production (i.e. citizen science)	○	○	○	○	○
Communicate scientific knowledge to lay audience or perform any type of public outreach	○	○	○	○	○

Proficiency in Open Science-related skills

How proficient are you in the following skills?

	Not at all	Basic knowledge	Advanced	Expert
1. Being able to use a script-based statistical software, e.g. R, Python, …	○	○	○	○
2. Pre-registering your work / analysis plan	○	○	○	○
3. Writing a data and / or software management plan	○	○	○	○
4. Version controlling (script, software, …)	○	○	○	○
5. Code / script annotation and documentation	○	○	○	○
6. Licensing software code	○	○	○	○
7. Collaborative (software) script development	○	○	○	○
8. Identifying and reusing open data	○	○	○	○
9. Creating reproducible reports, e.g. using (R) Markdown or Jupiter notebook	○	○	○	○
10. Creating interactive applications, e.g., R-Shiny	○	○	○	○
11. Collaborative writing	○	○	○	○
12. Sharing software code	○	○	○	○
13. Sharing data	○	○	○	○
14. Communicating your work to a lay audience	○	○	○	○
15. Communicating your work through social media	○	○	○	○
16. Critically review someone else's work and share the review openly	○	○	○	○

	Not at all	Basic knowledge	Advanced	Expert
17. Archiving your work in an open online repository	○	○	○	○
18. Adhering to the Findable, Accessible, Interoperable, Reusable (FAIR) principles	○	○	○	○
19. Publishing open access	○	○	○	○
20. Identifying Fake news	○	○	○	○

Which of these skills would you like to develop during the “Advanced Simulation for Health Economic Analysis” course, besides simulation modelling? Please select the three most important.

- ☐ 1. Being able to use a script-based statistical software, e.g. R, Python, …
- ☐ 2. Pre-registering your work / analysis plan
- ☐ 3. Writing a data and / or software management plan
- ☐ 4. Version controlling (script, software, …)
- ☐ 5. Code / script annotation and documentation
- ☐ 6. Licensing software code
- ☐ 7. Collaborative (software) script development
- ☐ 8. Identifying and reusing open data
- ☐ 9. Creating reproducible reports, e.g. using Markdown or Jupiter notebook
- ☐ 10. Creating interactive applications, e.g., R-Shiny
- ☐ 11. Collaborative writing
- ☐ 12. Sharing software code
- ☐ 13. Sharing data
- ☐ 14. Communicating your work to a lay audience
- ☐ 15. Communicating your work through social media
- ☐ 16. Critically review someone else’s work and share the review openly
- ☐ 17. Archiving your work in an open online repository
- ☐ 18. Adhering to the Findable, Accessible, Interoperable, Reusable (FAIR) principles
- ☐ 19. Publishing open access

☐ 20. Identifying Fake news

Open Science definition

How would you define Open Science? What are the different aspects of Open Science? Please provide a definition.

Conclusion

Please provide any feedback on this survey which you would like to share with us.