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Blessings of Open Data and Technology: E-Learning Examples on Land Use Monitoring and E-Mobility

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Abstract

The combination of theoretical knowledge and practice-oriented education are key for future professionals and young scientists. Open data and technologies are providing manifold opportunities within the scope of open science era. This paper aims to present the open e-Learning platform OpenGeoEdu (OGE) that comes with thematic learning module on best practice case studies with real open data. It presents a brief introduction on two best practices case studies: (i) land use monitoring and (ii) e-mobility. The major components of the learning modules are: lecture, test, and practical exercise; besides short teasers and technical tutorials. The multimedia features are: videos, scripts, interactive elements, real data, web-portal and so on. OGE is adopting mostly the open software/tools/frameworks for developing massive open online courses (MOOC) platform, preparing teaching materials and communication purpose. A brief evaluation shows that the OGE properties are addressing the key components and approaches of open science. In fact, everyone can enjoy to learn, participate, contribute and disseminate.

Keywords: Open data, Geo-spatial information, Land use monitoring, E-mobility, E-learning

1 Introduction

The term “Open” is promoting new approaches in science and education today by using the blessing of open digital innovations and collaborative tools, that were never experienced before in order to create/disseminate/maintain new knowledge. For doing so, the vision of open science wants to ensure participation of broader communities for tackling the global challenges together, given that the progress of science are key to innovation, growth and development pathway (Pardo Martínez & Poveda, 2018). The

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emerging approaches of open science is often mentioned: (i) democratic (ii) pragmatic (iii) infrastructure (iv) public and (v) measurable (Fecher & Friesike, 2013). The key components of open science are: open access, open data and open source (Jomier, 2017). Pisani et al. (2016) suggested to think even beyond such limited open components rather highlighted many other potential basic requirements – e.g. equitable collaboration, supportive infrastructure, investment for future data scientist, shared governance, interpretation and so on.

This paper aims to present the OpenGeoEdu platform (an open e-learning platform for fostering open data for education and science in geospatial domain) that comes with thematic learning module on best practice case studies. It introduces the content of e-learning modules: land use monitoring and e-mobility for promoting innovations of open data as well as technology.

The article is structured as follows: Section two includes a brief discussion on the related key terminologies and concepts. Section three introduces the basis structure/features of OpenGeoEdu platform, lessons learned during two-round online courses and the contribution within the scope of open science approaches. Two best-practice e-Learning modules are presented in section four. Last but not the least, the discussion of the OGE properties and further research scopes are discussed along with conclusion remarks.

2 Key Terms and Concepts

Before introduction to the “OpenGeoEdu” project, this section is briefly presenting and operationalizing to the selected terminologies and concept as below:

2.1 Open Data (OD)

Since late 90’s OD movement has been started to make the way forward, besides the advancement of internet. The Open Data Barometer is systematically measuring the trend and impact of OD with support of World Wide Web (www) foundation in every year at global level. Today, it is widely accepted as one of the important components of open science and promoting informed decision making. According to (Hasegawa & Asano, 2016), “OD means making data with a high level of public interest”. Initially, the data of government agencies were in focus; however, the companies, community agencies, individuals are beginning to make major contributions. For example, in Germany five

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federal state government authorities are providing of open basic geospatial dataset besides many city authorities. OpenStreetMap is already a known community lead platform at global level. Many interesting OD sources can be found on OpenDataPortal (a comprehensive collection of meta-information on data sources within German-speaking region as part of the OpenGeoEdu platform).

2.2 E-Learning

It refers to electronic media/tools in integration of information and communication technologies that may be used for training and education (Oye, Salleh, & Iahad, 2012). Before e-learning has been known as several other terminologies such as: web-based learning, virtual learning. Gogos (2014) mentioned that the term e-learning has been first-time introduced since 1999. Recently, the e-learning topic got a popular momentum ever, because of individual motivation of online learning. Many e-Learning courses are already launched by the educational institutions, public agencies (UN, FAO, GIZ) and commercial organizations (coursera, udemy, datacamp). As mentioned in El-Ala & Awad (2012), the e-Learning environments are existing in several types: virtual (VLE), personal (PE), mesh-up personal (MUPPLE); the IT systems and infrastructures largely depend on many dynamic and subjective factors. In order to make an efficient learning Chigbu et al. (2015) suggested to formulate specific objective, target, strategies and careful selection of media or tools.

2.3 Open Source Technology and Software (FOSS)

Since 70/80, FOSS is getting attention with the offers of the wider choice and customization options, besides the typical commercial entities. It has made to adopt new computational strategies for many business and organization (Koenig, 2004). A dedicated discussion on popular terminologies in relation to “open source” can be found in OpenXX (Bill, 2019). In the geospatial domain several initiative/projects have been initiated by diverse community – Steiniger and Hunter (2013) published a map of open source GIS software and tools. They suggested a number of guidelines and selection criteria for FOSS for business, research and teaching. According to Bill, Lorenzen-Zabel, and Hinz (2018), there are more than 20 leading e-learning platforms exist; however, four top-scored open-source platforms are ILIAS, Open edX, OpenOLAT und Sakai – as per result of a multi-criteria evaluation.

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3 OpenGeoEdu: An Open e-Learning Platform for the Geospatial Domain

OGE is not the unique initiative for providing e-learning platforms in the geospatial domain. A good number of offers are available from many international academic and commercial organizations under different business models. In the focus of German speaking region, some well-known e-learning platforms already exist (e.g. GITTA, geoinformation.net, FerGI); however, most of them became outdated due to technical compatibility and lack of active maintenance by integrating technological advancement (Bill et al. 2018). In fact, the ESRI Training/Education (Academy) provides many contents in relation to GIS applications; however, most of them are product-oriented. Like many other open online courses, OGE promises to offer topic specific self-question oriented explorative approaches of e-learning with open data where it ensures the best possible state of art in technical issues, multi-media content, and communication media. The major components in a learning module are: lecture, test, and practical exercise besides short teasers and technical tutorials. The multimedia components include: videos, scripts, interactive elements, a web-portal and so on. The lectures are introducing to the scientific state of art and background on the thematic case study topic. Upon completing the lecture section, the participant should be prepared for working with given exercises that deal with data and basic analytics. Participants are encouraged to pass a short test (max. 20 minutes) for each case study module.

Most of the practical exercises are designed in consideration of space (scale of analysis), time relation, scientific merit and practical relevance to the potential participants; however, there are open options if someone wants to choose a different study scale, study area, dataset and software packages. For doing so, each of the practical exercise prepared in three different format: Basic, Advanced and Click-by-Click (ABC). The Basic version describes the components: general problem, data research, modelling, visualization and interpretation; besides related clarifications, tips and tricks. The Advanced format introduces the tasks and guidelines for experienced learners. Both formats (Basic and Advanced) are independent and flexible to space, time and software requirements. The Click-by-Click version demonstrates an example for beginners with a specific spatial scale, time and software dependency. Every instruction is documented point-by-point with the necessary literature and further clarification; however, it does not include any results rather asked to produce.

Sujit Kumar SIKDER (1), Hendrik HEROLD (1), G. MEINEL (1), A. LORENZEN-ZABEL (2), R. BiLL (2)
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At this development stage, the project partners come from both educational and applied research institutions. They are: (i) the Chair of Geodesy and Geoinformatics (GG) at the University of Rostock is responsible for project coordination, platform design, implementation, maintenance activities; besides the development of fundamental modules, tutorials and thematic case studies (openXX, open data, e-mobility, noise mapping, GIS, landscape structure measures etc.); (ii) the Federal Office of Cartography and Geodesy (BKG) is contributing for case studies on remote sensing based geovisualisation. (iii) the German Biomass Research Centre (DBFZ) is responsible for the case of biomass potential; (iv) the Leibniz Institute for Ecological Spatial Development (IÖR) contributes to the topic of land use monitoring. Every partner contributes their thematic expert knowledge, services that can support practice oriented career preparation with the blessings of open data and technology.

The OGE is targeting the students that are related to geospatial domain such as geoscience, environmental science, urban planning, regional planning, agricultural and forest sciences; however, this can provide a learning opportunity to any interested individual or professional. OGE offers both tutored learning opportunity by following the timeframe or German University (need to be registered and timely submission) and flexible learning opportunities (do not need to register). A registered participant has the possibility to achieve credit points and certificated upon successfully completion of required tasks (minimum 1 credit points (CP) for 30 hours workload, maximum 6 CP for 180 hours workload). The submitted assignments are evaluated by the qualified teaching staffs rather than anonymous peer/automated evaluation methods. The course participants are encouraged to contribute to the learning platform development (bottom-up approach) through Q&A, forum and open repository (github).

There are three major principals to the development of OGE platform: learning to find open data, learning to use open data and test own learning with practical case studies. Therefore, the course modules are divided into fundamentals and case studies. The fundamental modules are covering the topics of openXX, Open Data and GIS (Fig. 76). The case topic start with an introduction to the topic and practical exercises that cover multiple scales (e.g. local to global). OGE provides an OpenDataPortal that includes most of the potential open data sources in Germany, Austria and Switzerland.

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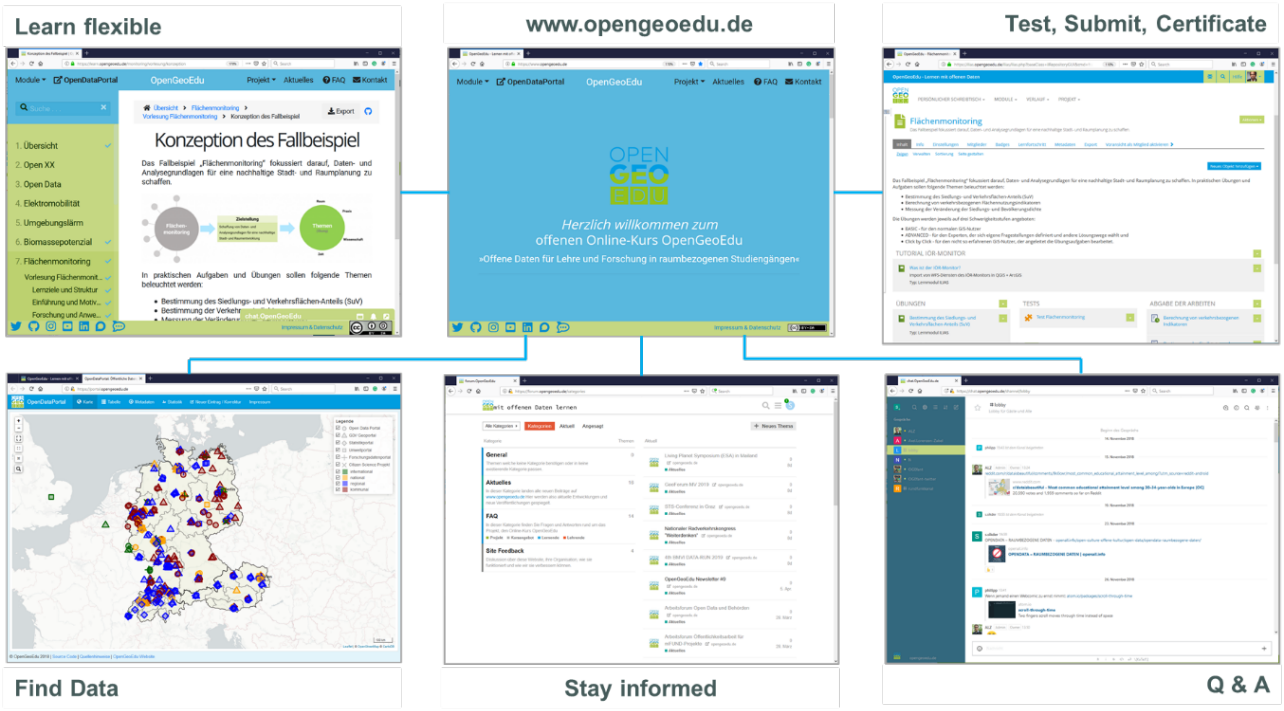

Fig. 76: *Key components of the learning platform. – Source: OpenGeoEdu, 2019.*

OGE aims to adopt the updated state of art in open software/tools/frameworks in the MOOC platform development, preparation of teaching materials and communication. To name some of the used software are: GRAV, ILIAS, GitHub, Rocket chat, R, GDAL, Shiny-server, QGIS, ArcGIS, ArcGIS-Online and so on. The required IT infrastructure is provided and maintained by the University of Rostock at this development stage.

The next section is dedicated to give a brief description of two best practice case study on land use monitoring and e-mobility.

4 Learning Modules – Example

OGE aims to develop an e-Learning platform for fostering the use of open geospatial data with practical case studies (best practice). This section is giving a brief insight about the current state of development by including learning goals, components on lecture materials and practical exercises.

4.1 Land Use Monitoring

The Leibniz Institute for Ecological Urban and Regional Development (IOER) is one of the research and development partners within OpenGeoEdu. The research area of

Sujit Kumar SIKDER (1), Hendrik HEROLD (1), G. MEINEL (1), A. LORENZEN-ZABEL (2), R. BiLL (2)
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“Monitoring of Settlement and Open Space Development” at IOER is responsible for the case study module on “Land Use Monitoring”. Since 2010, IOER is conducting research on this thematic issue and communicate several indicators in a form of open webGIS services called IÖR-Monitor (www.ioer-monitor.de). In general, the learning module should address the integrated topics of land use, existing buildings, green areas, and transport infrastructure.

A short teaser (2-3m video) is the first component of the learning components, which gives a brief introduction to the module. Secondly, a scientific lecture has been delivered to give a comprehensive introduction to the topic in the form of multimedia-video and script. It covers discussion on: key motivation, state of art, related data sources, methods/tools, related services/application and information on further learnings. Fig. 77 presents the basic concept of the learning module.

Fig. 77: *Basic concept of learning module – land use monitoring.*

Thirdly, a set of test questions are formulated in relation to the lecture content. Lastly, the practical exercises are offered on thematic topics for beginner to advance level. There are three exercises already available online - such as (i) computation of land use share for settlement and transportation (using WebGIS, QGIS), (ii) estimation of transport-related land use indicators (using OpenStreetMap, QGIS, WebGIS), and (iii) quantification and detection of changes in settlement and population density (using Open-GHSL, ArcGIS-online).

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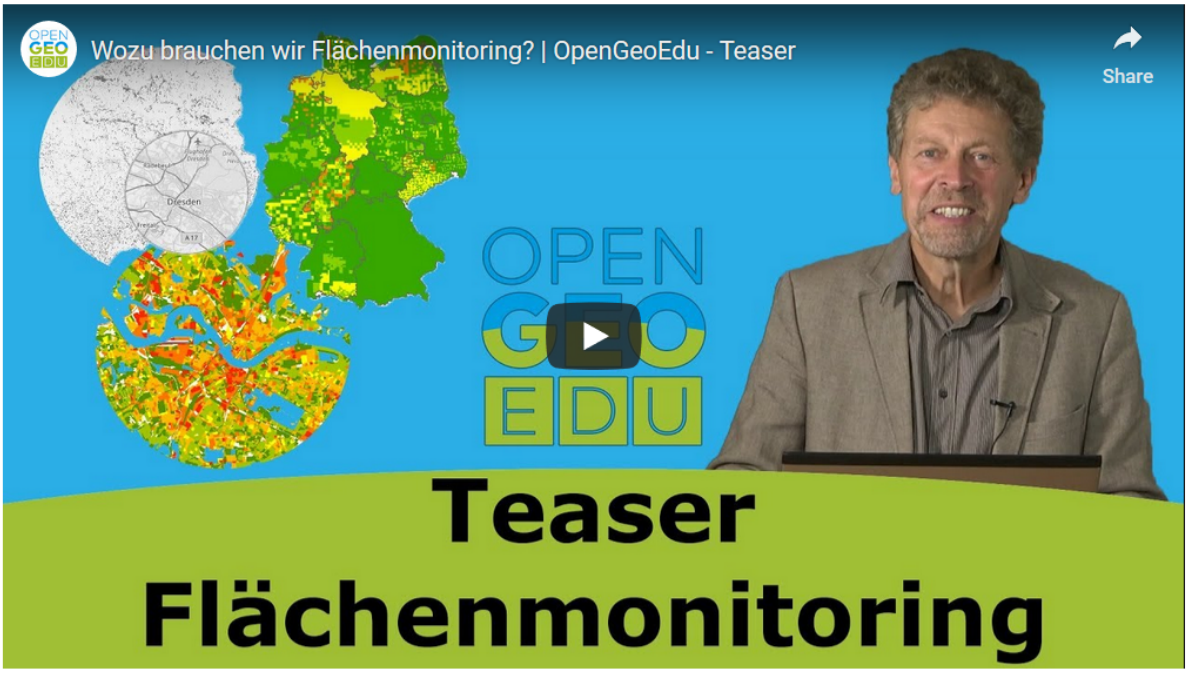
4.2 E-Mobility

The Department of Geodesy and Geoinformatics at University of Rostock is offering the case study on e-Mobility. The department has strong focus on research, development and teaching on the domain of geoinformation. The major goal of this learning module is to explore the spatial insight of e-vehicle charging infrastructures.

The lecture gives comprehensive discussion on motivation on this contemporary topic. The policy aspect of e-mobility infrastructure has been discussed along with demand and potential end user context. The case study relevant open data sources has been introduced and at the end further literatures. A pool of test questions are formulated to check the acquired knowledge of the module participants. There are 3 practical exercise on e-Mobility available online that covers multiple geodata, statistical open data and spatial scales: (i) assessment of accessibility to electric vehicle charging stations in the local environment, (ii) analysis of national charging infrastructure with respect to consumer potential of electric vehicles (EVs), (iii) planning a journey in Europe and evaluating this route with regard to the availability of charging stations.



Sujit Kumar SIKDER (1), Hendrik HEROLD (1), G. MEINEL (1), A. LORENZEN-ZABEL (2), R. BiLL (2)
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Fig. 78: *Short video teasers for introducing a learning module: e-Mobilty (left) and land use monitoring (right). Source: OpenGeoEdu (2019).*

The module component will be updated regularly with multimedia components, practical exercise, new data sources, and important reading materials and so on. Most of the components are openly accessible except the test questions and the delivery of achieved results. The registered course participants can also get some additional intermediated dataset for supporting intensive computational demand (it may help to overcome some limitations of high-speed internet connections, long processing time, simplify workflow for the beginners).

5 Lesson learned (course experiences)

The OGE-MOOCs have already administrated during winter semester 2018/2019 (October to February) and summer semester 2019 (April to September 2019). A total number of 245 registered participants (on ILIAS platform) were actively participating in tutoring, tests and practical exercises (Fig. 79). From the OGE course experience some important lessons have been learned on both general and technical issues.

The didactic preparative has to be intensified in order to ensure more attractive and understandable course contents. These need to be done by including more multimedia interactive content (video, graphics) rather than text. One of the initial obstacles was

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completing a mandatory user registration process for accessing to the course contents (tests, exercises); however, this has been relaxed since summer semester 2019 by providing all exercise contents completely open for all, besides lecture contents. The registration become an option, only if the participant wants to earn credit points and a certificate. On the other hand, this change may pose some limitation to gather statistics on experience, feedbacks, assessment from course participant for those who are only use the platform without registration. In fact, the online tests still remains one of the obstacles, because a course participant may not pass a test (within three times try) without completing of relevant lecture contents or/and may leave the course by thinking higher level of complexity. In our experiences, the course participants rarely used the provisions of OGE online communication services (chat, consultation hours, and user comments). Therefore, the challenges are often have to deal with active participation of the course participant for improving course content by taking direct user feedbacks. The third course is running for the winter semester 2019/2020 (October to February 2020). The course contents have been revised and new contents were added on thematic exercises.

Sujit Kumar SIKDER (1), Hendrik HEROLD (1), G. MEINEL (1), A. LORENZEN-ZABEL (2), R. BiLL (2)
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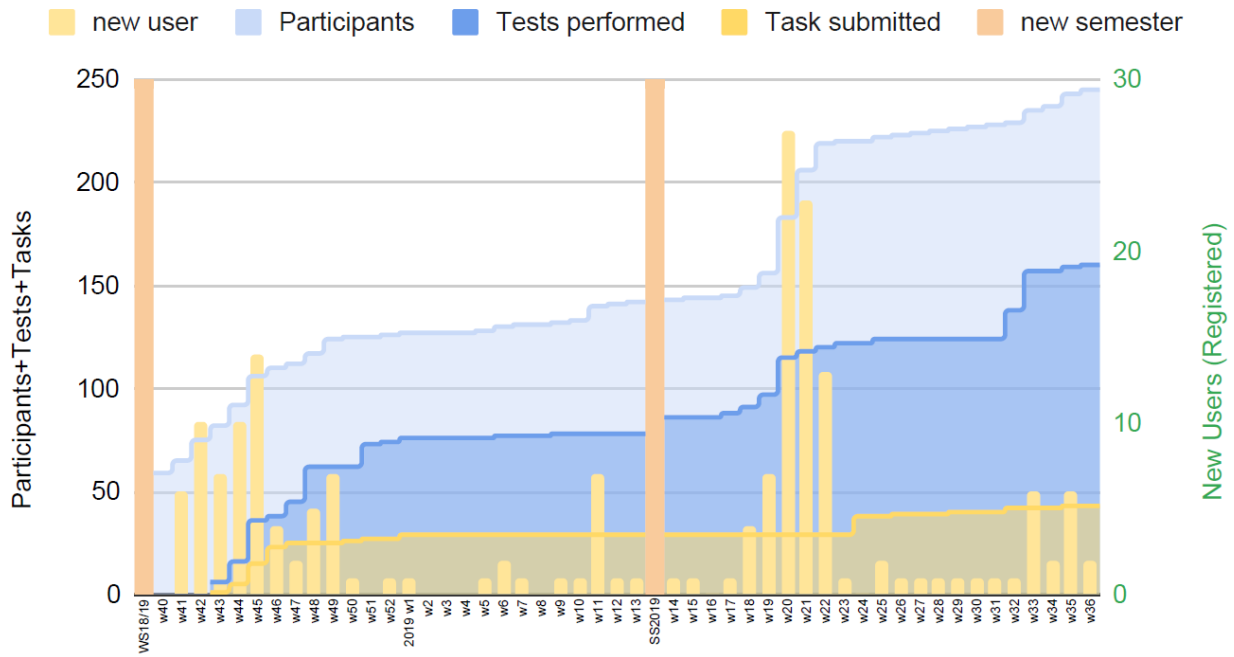

Fig. 79: *Statistics on registered course attendees and completed tasks. – Source: OpenGeoEdu (2019).*

6 Assessment of OGE according to Open Science Principals

OGE is dedicated to offer an open and flexible learning environment that can promote the use of open data. It is committed to address the updated development state of open data and software within the scope of open science. The following table shows an evaluation of OGE properties by following the major components and approaches of open science.

Approach	**Description**	**OpenGeoEdu**
Democratic	Free knowledge	Completely open and free (CC BY-SA 4.0)
Pragmatic	Create together	Intensive collaboration of multiple project partners (educational + applied research; teacher + students)
Infrastructure	Open platform, tools, services	Developing free/open eLearning platform; promote collaboration of teaching professionals
Public	Science for citizen	Targeted participants are spatial science; however everyone welcome to join and contribute. Learning offers cover Basic to Advanced levels
Measurement	Alternative impact of scientific contribution	Contribution and participation to the learning platform will increase visibility and impacts

Fig. 80: OpenGeoEdu in relation to open science approaches*. – Source: Author's Own, assessment by following to the OS approaches mentioned in Fecher and Friesike (2013).*

Sujit Kumar SIKDER (1), Hendrik HEROLD (1), G. MEINEL (1), A. LORENZEN-ZABEL (2), R. BiLL (2)
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OGE has mandate to facilitate collaboration, knowledge exchange and make social impacts. Some of them are already covered in the form of direct partnership/contribution and more may happen in indirect form. For instance, there are already some initiatives for e-Learning in Geospatial science in German speaking region. Most of them are suffering due to technical limitations; however, such content can be integrated/re-used within the modernized environment of OpenGeoEdu.

7 Conclusion

This paper presents a new open e-Learning platform OpenGeoEdu that offers topic specific learning modules with best practice case studies on spatial sciences. Two example learning modules have been discussed: land use monitoring and e-mobility. An overview on lesson learned has been reported that are experienced during two round online courses since October 2018. A brief self-assessment shows that the OGE has addressed most of the important components in relation to open science approaches. Within scope of OGE e-Learning offers, the exploration of thematic open data will be promoted rather than the product-related alternative e-learning offers – e.g. ESRI Academy. There are many challenges are remaining in order to reach potential participants and goals of OGE. In the future, the prospective participants need to be approached through different channels and their actively encouraged participate or communicate through the learning platform (e.g. newsletters, events/workshops, creative content related to current world events). This also includes the systematic collection of feedback from course participants and teachers (done so far mainly by questionnaires). The courses are still based on semester durations and will therefore be advertised for students and teachers. The next course will begin on the first of October 2019. In addition, anyone can use the course at any time and complete any part of the course.

The course participants have the opportunity to earn academic credits points (also certificate) upon completing all formal course requirements. However, the acceptance of the credit point by the participant host institution might be necessary to discuss further. The learning contents are available on open public platform (e.g. Github, ILIAS) under open license (CC-BY-SA 4.0). In future, the learning content will be updated regularly with new content, case studies, and data sources. Altogether, OGE may offer an environment for everyone to learn, participate, contribute and disseminate.

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References

Bill, R. (2019). OpenGeoEdu Grundlagen – open XX. Retrieved from https://learn.opengeoedu.de/openx

Bill, R., Lorenzen-Zabel, A., & Hinz, M. (2018). Offene Daten für Lehre und Forschung in raumbezogenen Studiengängen – OpenGeoEdu. *gis.Science*(1/2018).

Büttner, B., Kinigadner, J., Ji, C., Wright, B., & Wulfhorst, G. (2018). The TUM accessibility atlas: visualizing spatial and socioeconomic disparities in accessibility to support regional land-use and transport planning. *Networks and Spatial Economics, 18*(2), 385-414.

Chigbu, E. U., et al.(2015). *Land Use Planning for Tenure Security: An E-Learning Tool for Developing Countries.* Paper presented at the World Bank Conference on Land and Poverty.

El-Ala, N. A., & Awad, W. (2012). Cloud computing for solving E-learning problems. *International Journal of Advanced Computer Science and Applications (IJACSA), 3*(12).

Fecher, B., & Friesike, S. (2013). Open Science: One Term, Five Schools of Though. In F. S. Bartling S. (Ed.), *Opening Science*: Springer.

Gogos, R. (2014). eLearning

A brief history of elearning (infographic). Retrieved from https://www.efrontlearning.com/blog/2013/08/a-brief-history-of-elearning-infographic.html

Hasegawa, D., & Asano, Y. (2016). Latest trends and future outlook for open data: Making public-sector data available to the private sector. *Hitachi Review, 85*(1).

Jomier, J. (2017). Open science–towards reproducible research. *Information Services & Use, 37*(3), 361-367.

Koenig, J. (2004). Seven open source business strategies for competitive advantage. *IT Manager's Journal, 14*.

Oye, N., Salleh, M., & Iahad, N. (2012). E-learning methodologies and tools. *International Journal of Advanced Computer Science and Applications (IJACSA), 3*(2).

Pardo Martínez, C., & Poveda, A. (2018). Knowledge and Perceptions of Open Science among Researchers—A Case Study for Colombia. *Information, 9*(11), 292.

Pfenninger, S., Hirth, L., Schlecht, I., Schmid, E., Wiese, F., Brown, T., . . . Wingenbach, C. (2018). Opening the black box of energy modelling: Strategies and lessons learned. *Energy Strategy Reviews, 19*, 63-71. doi:10.1016/j.esr.2017.12.002

Pisani, E., Aaby, P., Breugelmans, J. G., Carr, D., Groves, T., Helinski, M., . . . Marsh, V. (2016). Beyond open data: realising the health benefits of sharing data. *Bmj, 355*, i5295.

Steiniger, S., & Hunter, A. J. (2013). The 2012 free and open source GIS software map–A guide to facilitate research, development, and adoption. *Computers, Environment and Urban Systems, 39*, 136-150.