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OPEN SPATIAL DATA INFRASTRUCTURE ACTIVE LEARNING AND TEACHING METHODS IN PRACTICE

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1. Introduction to open spatial data infrastructure education

1.1. Open Spatial Data Infrastructures

There is an increasing need for spatial data to be used for informed decision-making and as a resource for developing innovative products and services. A Spatial Data Infrastructure (SDI) facilitates access to and sharing of spatial data by providing a framework in which technical and non-technical aspects are established. Traditionally, SDIs are developed by and for government organisations to share spatial information within government. Non-government parties may also use SDIs to access government spatial data, either as open data or as fee-based data. There are also non-government SDIs, such as company SDIs used to share spatial information within a private sector organisation. OpenStreetMap is another example of a non-government SDI, whereby citizens have created a worldwide map based on crowd-sourced information and contributions from private and public sector organisations. The concept of Open SDIs has emerged from an increased interest in open data initiatives steered by national and international directives, such as the EU Open Data Directive (Directive (EU) 2019/1024), as well as the large investment of European public authorities in developing SDIs. Open SDIs are SDIs in which citizens, research institutions, private organizations and other businesses and non-governmental actors are recognized as key stakeholders of the infrastructure (Vancauwenberghe and van Loenen, 2018; Vancauwenberghe et al., 2018). The concept of Open SDIs is about openness to new stakeholders in the open data ecosystem, in which stakeholders can be both producers and users of spatial data. Open SDIs are also linked to developments and trends in other domains, such as open government, open data, open science, and open software. This new paradigm regarding Open SDIs means that new particular skills are required, which currently are not offered by traditional SDI education. Open SDI education requires a shift from teaching skills in single disciplines to a multi-disciplinary approach.

In addition to the content of the SDI education, a need towards more active teaching and learning in SDI arose. Several universities introduced this type of education for single topic classes but until

recently, there was barely any exchange of concepts and experiences, let alone guidelines or best practices on active teaching and learning on SDI.

1.2. The SPIDER Project

The Erasmus+ open SPatial data Infrastructure eDucation nEtwoRk (SPIDER) project integrates both developments by promoting and strengthening active learning and teaching towards Open SDIs. This paper describes how we researched, developed and implemented the concept of Open SDI as a new paradigm to SDI education. The SPIDER partners – Bochum University of Applied Science, Delft University of Technology, KU Leuven, Lund University, and the University of Zagreb – explored which active learning and teaching methods are already implemented in their SDI courses, and which methods can still be implemented.

1.3. Reading Guide

In Section 2, we provide an overview of our research of active teaching and learning methods. Section 3 describes the methodology we used to adapt and implement active learning and teaching methods to an online environment. We also describe selection processes for developing new topics to be implemented in SDI teaching. In Section 4, we show how we tested the newly developed active learning and teaching methods during the SPIDER Summer School, held 22-26 August 2022 in Zagreb. Section 5 provides our conclusions, reflection, and recommendations for active teaching in SDI courses.

2. Active Teaching and Learning Methods

Research has shown that the effectiveness of passive teaching methods may be questioned (Bonwell and Eison, 1991; Renkl et al., 2002; Michel et al., 2009). Research has also shown that students participating in active learning activities are engaged in higher-order thinking tasks such as analysis, synthesis and evaluation, and learn more than they do compared to traditional lectures (Deslauriers et al., 2019). Active Learning and Teaching is a broad concept, which refers to methods that will dynamically involve students in the learning process (Menekse et al., 2013). There are many different methods to actively engage students in the learning process, ranging from very short, e.g., one-minute papers, to long, e.g., problem based learning, and ranging from using traditional media to using multimedia technologies. Active learning activities can be especially effective in engaging students at higher learning levels according to Bloom's Taxonomy, as these higher levels are less attended in teaching methods (Welle Donker et al., 2022). According to this taxonomy, students engage lower levels of learning by remembering and reproducing information. At higher levels of learning, students are able to apply this knowledge and to analyse. At the highest levels of learning, students are able to critically evaluate information and to create new work, see https://www.bloomstaxonomy.net for more details. It should be noted that active learning is not limited to the classroom, but can also be performed outside the classroom. **Table 1** shows an overview of active learning activities categorised by learning levels according to Bloom's Taxonomy and for the different teaching environments.

Table 1. Active learning activities categorised by learning levels according to Bloom's Taxonomy and by teaching environment (source: Welle Donker et al., 2022)

Learning level according to Bloom's Taxonomy	on-campus teaching session	online teaching session	outside teaching sessions
Remember	demonstrations examples guest speakers in-class quizzes/polls	demonstrations examples guest speakers in-class quizzes/polls	clips podcasts class recordings short quizzes/ self-tests
Understand	asking questions active listening / paraphrasing one-minute paper / one-sentence summary brainstorm / brainwrite jigsaw in-class quizzes/polls mind map	asking questions active listening / paraphrasing one-minute paper / one-sentence summary brainstorm / brainwrite jigsaw in-class quizzes/polls mind map	literature / reader short quizzes / self-tests mind map
Apply	debate student presentations concept map	debate student presentations concept map	exercises serious games concept map
Analyse	muddiest point concept map / mini map active writing class discussions cases / role play / simulation think-pair-share / turn & talk / snowball group investigation as collaborative learning	muddiest point concept map / mini map active writing class discussions cases / simulation think-pair-share group investigation as collaborative learning	concept map
Evaluate	peer instruction peer review peer tutoring classroom quizzes	peer instruction peer review peer tutoring classroom quizzes	self-tests portfolio
Create	formulating exam questions mini lectures	formulating exam questions mini lectures	research paper case study / project formulating exam questions

3. Methodology

As part of the SPIDER Project, we carried out a literature review into active learning and teaching methodologies and evaluations in 2020-2021. In addition, we made an inventory of which methodologies were already implemented in SDI teaching at the SPIDER partners' universities. We carried out an evaluation of these methodologies in 2021 to assess in which way these practices were adapted to teaching in an online environment during the COVID-19 lock-downs. In our

evaluation, we included both students' assessment as well as teachers' assessment. In parallel, we organised a workshop for SDI education stakeholders in January 2022 in which we collected an overview of topics that should be included in Open SDI teaching. **Figure 1** shows an overview of the suggested topic and their relevance. The lessons learned were included in the development of new active learning and teaching methods, which were tested during the SPIDER Open SDI Summer School 22-26 August 2022 in Zagreb.

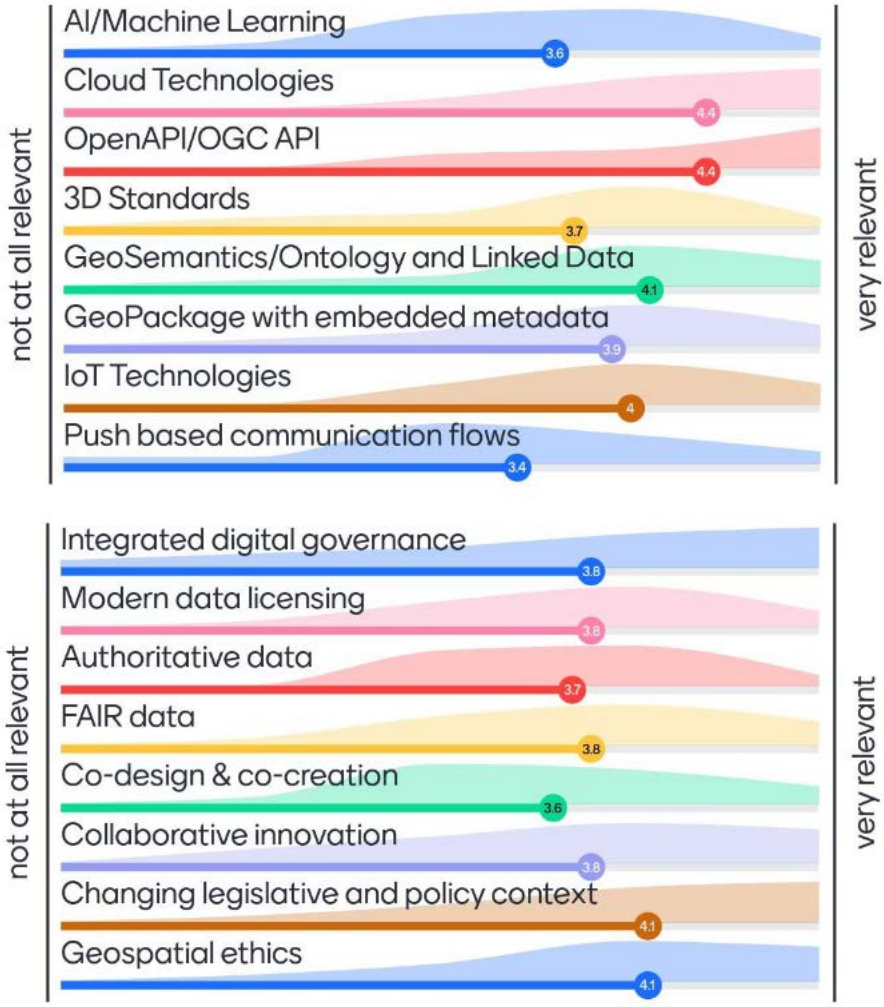

Figure 1. Suggested topics to be included in Open SDI teaching (source: Vancauwenberghe et al., in press).

A number of these topics, such as FAIR data and modern data licencing, are already covered in SDI courses of some of the SPIDER partners. Therefore, the SPIDER partners developed 10 topics that are new to the SPIDER partners' SDI courses. We tested the active learning and teaching methods that we intend to employ during the SPIDER Summer School 22-26 August 2022 in Zagreb. In this paper, we describe three of these topics: Private Sector Data in the Open SDI; Crowd-sourcing Spatial Data & Citizens' Science; and Ethical issues in Open SDIs.

4. Newly developed topics and active learning methods

4.1. Private Sector Data

In traditional SDIs, the private sector's role was primarily a user rather than a provider. With the economy becoming more data-driven, many companies and non-government organisations are creating their own SDI, e.g., Google, and OpenStreetMap. Some companies already made their spatial data or infrastructure openly available, e.g., Fugro contributing bathymetry data or Google making their infrastructure openly available during disasters to allow real-time updates. The European Union envisions a major role for G2B and B2G mechanisms and has introduced the concept of common data spaces that should ensure that more data becomes available for use, "while keeping the companies and individuals who generate the data in control". During the Summer School, students engaged in role plays, in which students represented different stakeholder groups. In one role play, students were provided with a description of the characteristics (e.g., responsibilities, funding, attitudes, desires) of "their" stakeholder (government policy makers, government data providers, European Commission, private sector SMEs, private sector big tech, civil society, and academia). In another role play, the stakeholders had to argue whether they should be included in the development of Open SDIs, or whether non-government organisations should be compelled to contribute their data to an Open SDI.

4.2. Crowdsourcing GI and Citizens Science

Nowadays, everybody can contribute to collecting data to monitor societal problems, such as noise pollution or air quality. Required technology becomes more accessible as smartphone apps and their hardware becomes more powerful to be used to gather data. Examples are GPS, sound meters and smartphone adaptors to measure air quality. The collected data can be a valuable contribution to Open SDIs. During the Summer School, groups of students went out on the street to collect noise data with a mobile app. The data, collected in different formats, were imported into GIS software, classified, and manipulated to visualise the data in a map, including elements such as coordination grid and various annotations. Not all students had any previous experience with data acquisition or data manipulation. These activities stimulated peer-assisted data acquisition and data manipulation as students had to decide as a team what should be included in the map.

4.3. Ethical Challenges of Open SDIs

With more data being collected and used for decision-making for society, there is a risk of unintended effects on individuals. More data or technology does not necessarily lead to better solutions; the context of "better" is extremely contextual, e.g., policing algorithms gone wrong. To demonstrate these complex issues, the Summer School students were introduced to the so-called trolley problem: a train trolley is moving on the tracks. The brakes of the trolley are broken. If the students do nothing the train will continue on the current tracks. If, however, students pull the lever, the train will be directed to a different track. The typical scenario is that not pulling the lever will kill five people, while pulling the lever will only kill one. Students were divided into distinct groups and had to decide whether to pull the lever given different scenarios. This resulted in heated debates on who should be spared and who should be sacrificed. As a second exercise, the students had to apply the Ethics Assessment List for Geoinformation Initiatives (EALGI) and test their case studies. EALGI was not specifically designed to be applied to open SDI, but retrospectively

it proved flexible enough to fit the task. Students were given half an hour for delivering a comprehensive application of EALGI to their case study, then provided feedback on the robustness of EALGI, and finally presented their results.

5. Conclusions, reflections, and recommendations

The SPIDER Summer School provided a good platform to test active learning and teaching methods for newly developed topics as the students were from diverse backgrounds. Although we only tested these activities in a classroom environment, parts of these activities can be adapted to an online environment or as activities outside the classroom. The crowdsourcing data acquisition proved to be very suitable as a team building exercise, important for future group work. The active learning activities also showed that activating the students is not only especially useful for transferring knowledge, but also a lot of fun.

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References

Bonwell, C. C., Eison, J. A. (1991). Active Learning: Creating Excitement in the Classroom. 1991 ASHE-ERIC Higher Education Reports [monograph]. ERIC Clearinghouse on Higher Education, The George Washington University. Available at https://eric.ed.gov/?id=ED336049

Deslauriers, L., McCarty, L. S., Miller, K., Callaghan, K., Kestin, G. (2019). Measuring actual learning versus feeling of learning in response to being actively engaged in the classroom. Proceedings of the National Academy of Sciences 116(39): 19251-19257. https://doi.org/10.1073/pnas.1821936116

Menekse, M., Stump, G. S., Krause, S., Chi, M. T. H. (2013). Differentiated Overt Learning Activities for Effective Instruction in Engineering Classrooms. Journal of Engineering Education 102(3): 346-374. https://doi.org/https://doi.org/10.1002/jee.20021

Michel, N., Cater III, J. J., Varela, O. (2009). Active versus passive teaching styles: An empirical study of student learning outcomes. Human Resource Development Quarterly 20(4): 397-418. https://doi.org/https://doi.org/10.1002/hrdq.20025

Renkl, A., Atkinson, R. K., Maier, U. H., Staley, R. (2002). From Example Study to Problem Solving: Smooth Transitions Help Learning. The Journal of Experimental Education 70(4): 293-315. https://doi.org/10.1080/00220970209599510

Vancauwenberghe, G., Lacroix, L., Casiano Flores, C., Welle Donker, F., van Loenen, B., Calzati, S., Keßler, C., Küppers, N., Panek, M., Mansourian, A., Zhao, P., Tomić, H., Kević, K., Poslončec Petrić, V., Bačić, Ž. (in press). Development of new active teaching practices SPIDER Project.

Vancauwenberghe, G., Valečkaitė, K., van Loenen, B., Welle Donker, F. (2018). Assessing the Openness of Spatial Data Infrastructures (SDI): Towards a Map of Open SDI. International Journal of Spatial Data Infrastructures Research 13: 88-100. https://doi.org/10.2902/1725-0463.2018.13.art9

Vancauwenberghe, G., van Loenen, B. (2018). Exploring the Emergence of Open Spatial Data Infrastructures: Analysis of Recent Developments and Trends in Europe. In S. Saeed et al. (Eds.), User Centric E-Government 25. Springer International Publishing AG. https://doi.org/10.1007/978-3-319-59442-2_2

Welle Donker, F., van Loenen, B., Keßler, C., Küppers, N., Panek, M., Mansourian, A., Zhao, P., Vancauwenberghe, G., Tomić, H., Kević, K. (2022). Showcase of Active Learning and Teaching Practices in Spatial Data Infrastructure (SDI) Education. AGILE: GIScience Series 3: 18. https://doi.org/10.5194/agile-giss-3-18-2022