ENVIHEI

Title of the PBL challenge:
Data visualization

Name of the responsible lecturer

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University / Department / Degree program

Silesian University of Technology / Department of Economy and Informatics / Bachelor's Degree in Business Analytics

Course / Subject in which implemented

2nd Course / Data Visualization

Implementation period (dates)

April 28, 2026 – June 26, 2026

Total duration (weeks/hours)

7 weeks / 15 hours

Number of students involved

53 students

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1. Project Design

1.1 Brief description of the project and the challenge proposed

The course was structured as a Problem-Based Learning (PBL) experience for students of Business Analytics.

The aim of the course was to develop practical skills in independently designing interactive data visualizations using Tableau and official Eurostat statistics to analyse and interpret phenomena related to selected dimensions of sustainable development: economic, social, and environmental.

1.2 Expected learning outcomes (academic and transversal competences)

Upon successful completion of the course, students were expected to develop the ability to:

- Retrieve datasets directly from Eurostat sources and correctly import them into the Tableau environment.
- Prepare data for analysis within Tableau, including joining and integrating tables, filtering information, and managing data structures, such as date formatting and geocoding.
- Select appropriate chart types, such as maps, line charts, and correlation plots, suited to the nature of sustainable development indicators.
- Create interactive dashboards and visual stories using advanced Tableau features, including filters, parameters, and calculated fields.
- Conduct comparative analyses of EU countries or regions regarding selected dimensions of sustainable development.
- Execute an independent visualization project, ranging from formulating a research problem and research questions to the final presentation and interpretation of data-driven conclusions.

Upon completion of the course, students were also expected to develop the following transversal competences:

- **Teamwork**: working effectively in small groups, flexibly assuming roles, sharing responsibilities, and taking responsibility for the collective outcome.
- **Project and time management**: planning project stages, organizing tasks, meeting deadlines, and coordinating activities with other team members.
- **Conflict resolution and negotiation**: engaging in substantive and evidence-based discussions, presenting arguments, and reaching consensus on project decisions, such as the selection of sustainability pillars and indicators.
- **Communication and data storytelling**: translating complex statistical data into a clear, engaging, and logical narrative for the audience.
- **Feedback skills**: constructively evaluating the work of peers and incorporating feedback to improve their own solutions.

1.3 Targeted sustainability competences

Students gained an understanding of selected dimensions of sustainable development and the methodologies used by the European Union to measure them. They became familiar with the principles of monitoring the Sustainable Development Goals (SDGs) under Agenda 2030 and developed the ability to independently navigate Eurostat databases to identify relevant socio-economic and environmental indicators.

In practical terms, students developed skills in the critical selection, processing, preparation, and interpretation of statistical data. They learned to identify and graphically represent relationships, trends, disparities, and inequalities among European countries in the context of environmental, social, and economic challenges.

The project fostered a systems-thinking mindset and increased students' awareness of global and local sustainability issues. It also prepared students to engage in evidence-based discussions supported by reliable quantitative data.

1.4 Sustainability approach and how it is integrated into the project

In this course, sustainable development was treated not merely as a theoretical concept but as a practical analytical framework. Rather than discussing sustainability issues in general terms, students adopted an evidence-based approach. Working in teams, students independently select two of the three sustainability dimensions (environmental, social, or economic), formulate clearly defined and measurable research problems, and investigate them using official statistical indicators. Examples include examining the relationship between GDP growth and CO_2 emissions or assessing how educational attainment influences the risk of social exclusion.

The integration of sustainable development into the Tableau project is organized into three successive stages:

- **Stage 1: Indicator Selection and Data Collection (Eurostat):** Students convert the selected sustainability dimensions into measurable variables by identifying appropriate Sustainable Development Goals (SDG) indicators within the Eurostat database. The selected indicators provide reliable evidence for analysing changes over time and differences across European countries and regions.
- **Stage 2: Data Exploration and Visualization (Tableau):** The process of creating visualizations in Tableau serves to uncover interdependencies. Students combine data from both pillars onto a single dashboard, allowing them to examine whether and how progress toward goals in

one area (e.g., the economy) affects the situation in another (e.g., the environment).

- **Stage 3: Synthesis and Data Storytelling:** The final stage focused on creating a coherent narrative using Tableau Stories or presentation materials based on Tableau visualizations. The charts presented are not an end in themselves, but rather a tool for drawing conclusions about how European countries are addressing sustainable development challenges.

1.5 Methodologies and tools used (PBL structure, facilitation techniques, etc.)

The course combined action learning, Problem-Based Learning, and peer learning methodologies. Students gradually progressed from acquiring individual technical skills to conducting collaborative analytical and conceptual work.

Phase I: Technical Skills Development (Weeks 1–3): The first stage focused on developing proficiency in Tableau. Student work was based on two complementary activities:

- Guided laboratory exercises: students completed structured tasks covering data import, creation of basic charts, calculations, and formatting.
- Individual mini-projects: each student independently developed original visualization mini-projects or mini-tasks applying the acquired skills. These were reviewed and discussed with the instructor in workshop sessions, providing opportunities for feedback and improvement.

By the end of this phase, students were expected to have developed a solid technical foundation for the subsequent collaborative project work.

Phase II: Project Development and Analysis (Weeks 4–7): The second stage involved working in project groups of three or four students, combining technical skills with subject-matter knowledge.

Teams carried out a complete research cycle:

- Selecting two sustainable development dimensions.
- Defining a research objective and detailed research questions.
- Identifying and collecting relevant indicators from the Eurostat database.
- Preparing, integrating, and analysing data within Tableau.
- Developing advanced interactive dashboards addressing the research questions.

Phase III: Evaluation and Defence: The course concluded with a group oral presentation and defence of the results obtained. Teams could choose between two presentation formats:

- Interactive presentation: presenting directly in Tableau using the Tableau Stories feature, allowing dynamic exploration and real-time interaction with the dashboards.
- Traditional presentation: using PowerPoint slides based on static screenshots of the Tableau dashboards.

Regardless of the format selected, students were expected to demonstrate their ability to synthesize conclusions, correctly interpret Eurostat indicators, explain their analytical results, justify their choice of visualization methods and dashboard design, and present well-supported conclusions.

1.6 Organization of the project (group formation, timeline, milestones)

1. Group formation

Students worked in groups of up to four members. Groups were self-selected and were submitted to the instructor by the end of Week 3. It was recommended that students who demonstrated strong Tableau competencies during the Phase I individual mini-projects take key technical roles within the teams, while all team members contributed to the analytical and research components of the project.

2. Timeline and milestones

The project work was organized into three consecutive one-week sprints, each ending with a clearly defined milestone and tangible project deliverable.

Week 4: Project Concept and Data Collection

Student activities:

- Team brainstorming sessions.
- Selection of two sustainability dimensions.
- Definition of the research problem and 3-4 research questions.
- Identification, collection, and preliminary cleaning of Eurostat datasets.

Instructor support:

- Consultations and approval of project topics.
- Verification of dataset suitability for addressing the research questions.

Milestone 1: Project Charter (End of Week 4).

Deliverable: team composition, selected sustainability dimensions, research objectives and questions, chosen Eurostat datasets.

Week 5: Dashboard Development and Prototyping

Student activities:

- Importing datasets into Tableau.
- Creating data relationships and calculations.
- Developing visualizations.
- Designing dashboard layouts.
- Building the first project prototype.

Instructor support:

- Technical consultations on data integration, calculations, filtering, and troubleshooting.

Milestone 2: Dashboard Alpha Version (End of Week 5).

Deliverable: functional .twbx file containing completed charts and interactive filters. Final visual design and textual explanations are not yet required.

Weeks 6–7: Finalization, Storytelling, and Presentation

Student activities:

- Refining dashboard design, readability, and user experience;
- Developing the final narrative;
- Preparing a Tableau Story or PowerPoint presentation.

Instructor support:

- Final content and design review based on peer-feedback activities.

Milestone 3: Final Project Defence (Class in Week 6 or 7). Deliverable: submission of the completed project file through the course platform together with a 10–15-minute group presentation demonstrating the analytical process, key findings, and interpretation of the results.

1.7 Deliverables requested from students (type, format, deadlines)

Students are required to submit a complete and original analytical project that includes:

- Eurostat datasets imported into Tableau.
- Data preparation and transformation procedures.
- At least two linked interactive dashboards utilizing filters and/or dashboard actions.
- A narrative component developed through Tableau Stories.

Submission format: .twbx (Tableau Packaged Workbook), which contains the complete Tableau workbook together with all associated data sources, ensuring that the project can be opened and evaluated without requiring external datasets.

1.8 External collaborators involved (mentors, companies, experts...) and their role

No external collaborators were involved in this implementation.

2. Project Evaluation

2.1 Assessment criteria and methods used

The group project accounts for 100% of the grade for this part of the course (or the corresponding weight in the final grade). Points are awarded across four main categories (Table 1).

Table 1. Assessment criteria and project weightings.

Assessment Category	Evaluation Criteria	Project Weight
Project Structure and Timeliness (KM1)	Timeliness and correctness in defining the research problem and research questions	10%

Data Handling and Content (Eurostat & SDG)	Timeliness and correctness in a) selecting indicators for the pillars of sustainable development, b) cleaning and combining data, c) completing initial charts and dashboards	30%
Technical Sophistication and Design (Tableau)	Timeliness and correctness in completing final visualizations and dashboards	40%
Oral Presentation and Project Defence	Timeliness and correctness in project presentation and answering research questions using the created dashboards.	20%
TOTAL		100%

2.2 Evidence of student learning (examples, outputs, results)

The following learning outcomes provide direct evidence of students' achievement throughout the course:

- **Interactive Tableau Dashboards**: Students develop original and fully interactive Tableau dashboards that enable users to explore, compare, and evaluate trends associated with two selected pillars of sustainable development. These dashboards demonstrate the effective application of data visualization principles to support evidence-based analysis.
- **Project Presentation and Defence**: Students showcase their learning outcomes through a group presentation, during which they explain their research objectives, interpret key findings, and provide well-reasoned justifications for the conclusions drawn from their Tableau analyses.
- **Understanding and Application of the SDGs**: Students demonstrate their knowledge of sustainable development concepts by selecting relevant Eurostat indicators and establishing clear connections between these measures and the Sustainable Development Goals (SDGs) and targets outlined in the United Nations Agenda 2030 framework.
- **Data Literacy and Statistical Data Management**: Students provide evidence of their ability to independently identify, assess, organize, and preprocess official Eurostat datasets. This includes preparing economic, social, and environmental data for meaningful analytical investigation.

- **Business Intelligence and Tableau Competencies**: Final project outputs demonstrate students' practical proficiency in Business Intelligence and Tableau. Students apply techniques such as data preparation, calculated measures, interactive filtering, dashboard design, and advanced visualization development to communicate complex analytical insights in a clear, accurate, and methodologically rigorous manner.

3. Reflections and Recommendations

3.1 Main achievements and strengths of the project

The students selected for the project were highly motivated and committed, resulting in high-quality projects. Furthermore, their engagement throughout the project process was reinforced by the fact that the students chose topics related to their interests. The students effectively linked the project indicators to the official Sustainable Development Goals (SDGs) and their specific targets. The PBL method was effective in solving real-world problems, inspiring the group, and developing their communication and collaboration skills.

3.2 Challenges faced and how they were addressed

Several methodological and technical challenges were identified during the implementation.

Defining research problems and research questions

At the beginning of the projects, students encountered difficulties in transforming broad sustainability-related topics into specific research problems and coherent research questions supported by measurable indicators.

This challenge was addressed through regular consultations with the instructors, during which students received guidance on refining research questions and developing their analytical approaches. The course materials

were subsequently revised for future editions to include additional practical examples and more structured methodological guidance, particularly within the introductory mini-projects.

Data availability and indicator selection

Students also encountered challenges related to data availability, indicator selection, data integration, and ensuring that the selected variables were suitable for comparative analysis.

These challenges were addressed through consultations with the instructors and the application of data-driven analytical methods. Students received support in selecting appropriate Eurostat datasets, preparing the data, and structuring their analyses.

Data integration and analytical interpretation

Some projects involved a large number of indicators and multiple sustainability dimensions, which made it difficult for students to integrate the data into a coherent analytical framework.

For example, the Pulse of Development project required the simultaneous analysis of economic, health, and social dimensions. Students structured the project around a hierarchy of research questions, with separate dashboards dedicated to individual dimensions and an integrated summary dashboard enabling comparisons across dimensions.

3.3 Lessons learned for future implementations

The implementation confirmed that combining Problem-Based Learning, official Eurostat data, and Tableau-based visualization provides a framework for developing analytical competencies and sustainability awareness.

The experience showed that students benefit from stronger initial guidance in research design, particularly when transforming a broad sustainability topic into a clearly defined research problem and selecting appropriate indicators. Future implementations could introduce additional examples of well-formulated research questions at the beginning of the course, which could improve the quality of final projects.

The projects demonstrated that successful sustainability analysis depends heavily on data literacy skills, including data selection, validation, cleaning, integration, and interpretation. Future implementations may therefore benefit from dedicated sessions on data quality assessment and statistical interpretation.

Further emphasis could also be placed on analytical interpretation. While students successfully developed Tableau dashboards, additional guidance on assessing data quality, understanding methodological limitations, explaining relationships between indicators, and formulating evidence-based conclusions could strengthen the analytical dimension of the projects.

The strongest projects integrated multiple perspectives rather than examining sustainability dimensions in isolation. Students explored how economic growth, environmental protection, public health, and social well-being are interconnected and may involve relationships and trade-offs that cannot be understood through a single indicator. Future project designs should continue promoting interdisciplinary analyses that encourage systems thinking and a broader understanding of sustainable development challenges.

At the same time, the implementation showed the value of allowing students to select sustainability-related problems according to their interests. This flexibility contributed to diverse and original projects and supported student engagement.

One imbalance was observed in the selection of sustainability dimensions, with many projects focusing on economic and social dimensions and comparatively less attention being given to environmental issues. Future editions could place greater emphasis on encouraging projects related to environmental challenges or consider requiring students to incorporate all three sustainability dimensions into their analyses.

The projects demonstrated that students were able to successfully connect their analyses to several Sustainable Development Goals (SDGs), like:

- **SDG 7**: Affordable and Clean Energy through the examination of renewable energy development and energy accessibility.
- **SDG 8**: Decent Work and Economic Growth through analyses of GDP growth, employment, unemployment, and economic resilience.
- **SDG 12**: Responsible Consumption and Production through the assessment of resource use and environmental pressures.
- **SDG 13**: Climate Action through the exploration of environmental degradation and sustainability trade-offs.
- **SDG 14**: Life Below Water through analyses related to marine protection and environmental preservation.

Future editions of the course could further strengthen these connections by explicitly requiring students to map each selected indicator to specific SDG targets and policy objectives.

4. Supporting Material

4.1 Lecturers' materials and project documentation

Lecturers' materials and project documentation are available in the following link:

https://drive.google.com/drive/folders/1alz7JfdZnMk78TOhij_8IxBtz41iu4xw?usp=drive_link

4.2 Deliverables produced by students, final presentations or pitch materials

An example of deliverables produced by students is available in the following link:

https://drive.google.com/drive/folders/1h2rZubx4SN_ZdFX7OcbDpA6zNAa4N4DE?usp=drive_link

Students' final presentations are available in the following link:

https://drive.google.com/drive/folders/1saqG4_KsxNyKIIoZ4x2qrIbbQlLw7Yus?usp=drive_link

4.3 Images/videos (with consent)

Photographic and video records were captured with the explicit consent of the participating students, and are available in the following link:

https://drive.google.com/drive/folders/1cvUdWIzClCF1Q_yafdKuHryGKiiBq1nj?usp=drive_link

4.4 Any other relevant material

All the materials, including this report, are available in the following link:

https://drive.google.com/drive/folders/1HJL4ccESOBgJrwcD-I7WnairbqZ5ct2N?usp=drive_link