

Let's Talk with Data!

A Project Based Learning with Excel

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1 MY STUDENTS' CLASS

This project is designed for the class 5ET of the fifth year in the curriculum *Settore Economico per Indirizzo Amministrazione, Finanza e Marketing* of the *Istituto Tecnico Piovene*¹, in Vicenza, Italy. The class is composed by 19 students. The average age of the students is 18 years old. There is one student with a mathematical learning disorder. This laboratory is conducted in the first semester, i.e. in October, in the subject "*Matematica*". As in the "*Linee Guida - Istituti Economici*" [1] in the fifth year they have three hours per week on Mathematics.

2 CURRICULUM

Following the "*Linee Guida - Istituti Economici*" [1] for the fifth year, this project is on: (i) use and critically evaluate statistical information from different sources, and (ii) carry out research and surveys of comparison, optimization, trend, etc., related to applications of their curriculum, i.e. *Amministrazione, Finanza e Marketing*. From previous years the students have already seen the basics of statistics and they are familiar with Excel. They know the basic use of the spreadsheet, the **Home** drop-down commands, and some basic of the **Formule** drop-down commands, e.g. **sum**, **mean**, **median**, **min**, **max**, **variance**. They also know the drag of a formula and tables.

3 TECHNOLOGY: EXCEL

Microsoft Excel² is a program dedicated to the production and management of spreadsheets. Research, e.g. [5], suggests that spreadsheet software is equipped to be a particularly fruitful application of technology in the mathematics classroom. And it is well known that the use of technology support learner-centred strategies that address the diverse needs of all students in learning mathematics, as these strategies help students become responsible for and reflect on their own learning. The project aim to be student-centered and engage students in an active learning through technology. This project aims to implement the curriculum plans applying appropriate technologies to maximize student learning and creativity in mathematics.

4 PROJECT BASED LEARNING

Project-based learning³ (PBL) is a pedagogical approach that involves students designing, developing, and constructing hands-on solutions to a problem. The educational value of PBL is that it aims to build students' creative capacity to work through problems, commonly in small teams. The main characteristics of PBL are: (i) is student centred; (ii) encourages active learning and critical thinking; (iii) is an effective model for learning; (iv) emphasizes the process not just knowledge; (v) students develop solutions to problems; (vi) students create visual and multimedia material; (vii) involves a more long term project where students explore possible answers; (viii) students solve real-world problems; (ix) focus on creativity and collaboration. Research finds that engaging in project-based learning significantly increased the formal and technological knowledge of students [4].

5 PROJECT DESCRIPTION

- **Team Working and Roles Definition.** Students work collaboratively, that is, in groups of three, sharing ideas and trying to convince each other. This approach resembles the processes that the scientific community uses to acquire knowledge or the team work in a company. Before starting the project they have to define the roles within their team: there are three possible roles namely statistician, researcher and developer. All participants in the group have to follow the whole project, but each of them have a special role of responsibility for a certain aspect. This is to put on the same level of importance: (1) the content aspect, i.e. statistical formulas and graphs, (2) the technological aspect, i.e., Excel, and (3) the aspect of understanding and sensitivity to the result, to move away from the idea of "I'm done when I get a number as a result." The importance is to understand the meaning of that number. Working in groups is also a supportive strategy for the MLD, i.e., students help each other and the group takes advantage of each other's strengths.
- **Real World Project.** As in [3], in STEM courses the inclusion of project based learning strategies is

¹<https://itepiovene.edu.it/>

²<https://www.microsoft.com/it-it/microsoft-365/excel>

³<https://www.dyndevic.com/it/news/project-based-learning-pbl-cos-e-come-funzione-ELN-1639/>

effective to involve students in authentic real world tasks. This project is real world based, i.e. they are a team in a company and they have to respond to a customer's request. The client is Miss Finicky, she is the director of a bank called *ILoveStatistic*, which operates in the Italian territory. She sends to the team a dataset about the loan applications received in September. The dataset contains personal information about the bank's customers, such as gender, whether the customer is married, dependents, age, whether customer is self-employed, and the customer's income. It also contains information about the loan granted to the customer by the bank. She requests: (i) a dashboard describing the main characteristics of the bank's customers who have requested a loan from the bank in September; (ii) know if data regarding customers' income might be falsified; (iii) understand the relation between the applicant income and the loan amount allowed.

- **Long Term Project.** Research underline the importance of end the myth that good mathematics performance is about calculating fast; a number of mathematicians are working to change this idea, explaining how they think slowly and deeply about mathematics. Strong mathematics learners are those who think deeply, make connections and visualize [2]. With this aim this project has a duration of two months distributed as follows: one hour of class per week plus continuing work at home, to give the time to think, research, try and revise. The project is divided into three phases and each phase has a deadline that corresponds to the delivery and/or presentation of the work.
- **Project Organization.** PBL takes students through the following steps⁴: (1) *identify*: identifying the research project questions; (2) *generating ideas*: students brainstorm and discuss their ideas; (3) *designing and developing a prototype of the solution*: the purpose of prototyping is to expand upon the ideas generated during the brainstorming phase and to convey a how a solution to the problem might look and feel; (4) *testing*: the results of testing can provide students with important feedback on the their solutions, and generate new questions to consider.
- **The Role of Teacher.** The direction approach of this project is student directed inquiry where students determine what and how they want to study and what they will present. The teacher sets the stage and guides or facilitates the process if necessary. Research [4] suggests that students learn more from working on unstructured projects than they do on highly structured ones. Unstructured projects are sometimes referred to as "open ended," because they have no predictable or prescribed solution. In this way, open

ended projects require students to consider assumptions and constraints, as well as to frame the problem they are trying to solve. The role of teachers are also in meta-cognitive regulation to teach students how to think and act as scientists [4]. Teachers can focus on improving students' thinking skills, building a culture of inquiry in the classroom, planning and assessment. Moreover another role of teachers is organizing student learning in groups and focusing on collaboration processes.

- **Outcome and Presentation.** Each step of this project concludes with the creation of a multimedia material that will be delivered and/or presented to the class. The teacher will explain that each output made by the groups can be made as they prefer, e.g. a power point, poster, verbal description or computer writing. They can use whatever form of expression they prefer to deliver the results of the various stages of the project. Creativity and multiple representations are the key words as advocated in [2], not only for the outcome but for all the process, from the brainstorming to the presentation.
- **Assessment.** After the presentation each group evaluate them self and the other groups according with this sub-abilities: (i) is able to select the data to represent for the customer's request; (ii) is able to represent data in a meaningful way; (iii) is able to analyse the results appropriately; (iv) is able to describe and compare the results; (v) is able to analyse the meaning of the results; (vi) is able to organize the project work (vii) is able to present results in a understandable way. After the self and peer assessment each group can revise if necessary their work.

REFERENCES

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⁴<https://www.bu.edu/ctl/guides/project-based-learning/>