Author: Noemi Bertoni

# FAIR OR NOT FAIR? THAT IS THE QUESTION!

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| **School** | ☐ Primary ☑ Middle ☐ High |
| **Year / Class** | ☐ 1 ☑ 2 ☐ 3 ☐ 4 ☐ 5 |
| **Subject** | Mathematics |
| **Topic** | Probability |
| **CLIL language** | English |

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| **Teacher profile** | Teacher's role: | ☑ Main Teacher<br>☐ Co-teacher<br>☐ Other: _____ |
| | Subject taught: | Mathematics |

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| **Student group profile (general)** | CEFR Level: | ☑ A1<br>☑ A2 | ☐ B1<br>☐ B2 ☐ C1<br>☐ C2 |
| | ☑ Experiences of CLIL<br>☐ English mother tongue<br>☐ Other mother tongue | | ☐ Migrant background<br>☐ Special Educational Needs:___<br>☐ Other: _____ |

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| **Timetable fit** | ☐ Module ☑ Lesson |
| | **Previous lessons** |

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| | a. **Introduction to probability**: students watch a video (topic: games of chance/lotteries) and the teacher brainstorms their ideas about fortune, mathematics and risk in every day real life. They then play the Lotto game all together discussing their results.<br>b. **How likely is that…?**: using flashcards students work in pair to classify events according to their likelihood. They distinguish between "certain", "likely", "unlikely" and "impossible" events. They then order the given events from the least likely to the most likely. Students use comparative forms to compare couples of different events ("… is less/more likely than …").<br>c. **What's the probability of…?:** students learn that the probability of an event is a number between 0 (impossible event) and 1 (certain event). They work in groups to order events from a list on the probability line between 0 and 1. They then compare their answers justifying their choices. "Why is probability useful?" Students think about some examples of how probability can be used to make decisions.<br>d. **Symmetry, equi-probability and fairness**: students are shown a picture of astragals (the ancestors of dice) that Greeks and Romans used as a pastime or for making predictions about their future. "Are astragals fair dice?" Students think, pair and share their answers. They then work in groups to create dice of different shapes starting from printed solid nets and following a list of given instructions. The different groups exchange their dice in order to establish which ones are fair and which are not fair and why. At the end of the lesson students answer the question: "How can we 'load' a fair die?"<br>e. **Classical theoretical probability**: students work in groups to establish the probability of simple events linked to the rolling of fair dice (e.g.: "Annie rolls a 6-sided fair die, what's the probability of getting an even number?"). They then try to establish criteria to calculate the probability of an event: "the probability of an event is given by the number of desired outcomes divided by the number of possible outcomes". Students are now able to solve different kinds of problems and exercises using equivalent ways of answering (i.e.: "3 out of 6" is equivalent to "3:6", to "1/2", to "0,5" or to "50%"). |
| | **Future lessons** |

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| | **a. The law of large numbers**: in the next lesson students discuss the results obtained from their homework. They observe how the relative frequency changes as the number of coin tosses increases. They then compare their results with the theoretical probability. This leads to the so called Law of Large Numbers: "the more times you repeat an experiment, the closer the relative frequency comes to the theoretical probability". Students discuss on how insurance companies use probability to set premiums for different kinds of insurance.<br>**b. Experiments vs simulations**: students are shown what a dice simulator is. They then work in pairs to generate random numbers in Excel spreadsheets. Following the instructions written on a handout worksheet students simulate the roll of a tetrahedral die for 1000 times, collect data in a table and do a graphical representation of the results. They then complete a guided report into a Word file. The results obtained by the different groups are compared and students discuss about the difference between an experiment and a simulation.<br>**c. Compound probability**: students are asked to solve the following problem in groups: "You roll two cubical dice. What's the most likely total you can get? What about rolling a tetrahedral die and an octahedral die?" The different problem solving strategies are then compared. Students can now solve different kinds of problems and exercises using different strategies (e.g.: tables, tree diagrams…).<br>**d. Assessment**<br>- **Formative assessment**: students work in pair or in groups for most of the time. They know what the learning outcomes and assessment criteria are, they give feedback to each other (peer assessment) and learn how to assess their own progress (self assessment). Teacher observes and collects data during all the collaborative group works in order to give students constructive feedback.<br>- **Summative assessment**: students do a test with different kinds of exercises with different levels of difficulty. |

| | **Subject** | **Language** |
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| **Students' prior knowledge** | - The equivalence between fractions, decimal numbers and percentages.<br>- Methods and steps of a statistical survey.<br>- Absolute and relative frequency.<br>- The principal graphic organizers and their specific purpose.<br>- The structure of a laboratory report. | - Comparative and superlative forms.<br>- Present Simple.<br>- Basic math vocabulary.<br>- Question forms and answer forms.<br>- The modal verb "can". |

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| **Students' prior skills** | - Be able to convert between fractions, decimal numbers and percentages.<br>- Calculate absolute and relative frequency.<br>- Represent statistical data graphically by hand or using Excel. | - Use comparatives and superlatives.<br>- Be able to give short such as long answers.<br>- Use "can" to express possibilities. |
| **Students' prior competencies** | - Collect, analyse and graphically interpret data.<br>- Problem-solving skills (analyse the text of the problem to identify useful information, formulate a strategy, apply that strategy, evaluate the solution and justify procedures).<br>- Write a laboratory report. | - Use language to express facts and opinions. |

| | **Cognitive skills and attitudes to learning** | **Communication skills** |
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| **Learning Outcomes expected for the module** | - Connect probability to real world.<br>- Play probability games and identify all possible outcomes.<br>- Classify events as "certain", "likely", "unlikely" or "impossible".<br>- Compare and order the likelihood of simple events.<br>- Recognize the difference between outcomes that are equally likely and not equally likely to occur.<br>- Identify what a fair game is and how to turn an unfair game into a fair one or vice versa.<br>- Represent and interpret probabilities as fractions, decimals and percentages between 0 and 1.<br>- Know the formula for finding the theoretical probability of an event.<br>- Apply the formula of the theoretical probability.<br>- Theoretically and experimentally examine probabilities in games of chance.<br>- Understand how experimental probability can be used to make decisions.<br>- Use simulations to investigate probabil- | - Use everyday language to talk about chance.<br>- Know and use the subject specific language.<br>- Develop use of comparatives and superlatives.<br>- Develop use of "can" to express possibilities.<br>- Develop use of language for predicting, hypothesizing and justifying.<br>- Develop use of passive forms in stating formulas. |

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| | ity in common situations.<br>- Understand the difference between an experiment and a simulation.<br>- Know the law of large numbers.<br>- Develop problem-solving skills.<br>- Evaluate peer/own work using given criteria.<br>- Cooperate with others. | |
| **Learning Outcomes expected for this lesson** | - Theoretically predict probabilities in games of chance.<br>- Collect, analyse and graphically interpret data.<br>- Compare theoretical and experimental probabilities.<br>- Evaluate own work using given criteria.<br>- Cooperate with others. | - Use everyday language to talk about chance.<br>- Know and use the subject specific language.<br>- Develop use of superlatives.<br>- Develop use of language for predicting, hypothesizing and justifying. |

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| **Methodology** | "Data and predictions" is one of the most challenging nuclei of the Mathematical Curriculum for the First Cycle School level: studying Statistics such as Probability students can appreciate the relevance of mathematics to their lives.<br>The lesson I have chosen is problem-based and takes approximatively two hours to be developed. After the presentation of the problem and according to the scientific method, students work in groups to formulate predictions, collect data, analyse results and state their conclusions. The worksheet[1] they are asked to complete has the structure of a scientific/laboratory report. Breaking down the task into small steps helps them to monitor which stage of the enquiry they have reached. Moreover, it is a way to develop a critical approach to text types.<br>While the problem-solving technique lets students understand the purpose of their activity and find learning challenging and motivating, the cooperation increases communication skills and enables students to provide scaffolding to each other. In this activity they work in small heterogeneous groups where each member has a specific role. The teacher assigns roles according to the skills students need to develop: everyone should experience a suitable level of challenge to achieve his/her own potential. Roles are written on cards with the addition of linguistic structures useful to communicate during the task[2]. |

[1] See Attachment_4 (and Attachment_5 for an example of differentiation for less able students).

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| | Before the end of groups' activity students can improve their Information Technology competencies using Excel to do the graphical representation of their results. Each group shares its graph on Padlet[3] and the spokesperson presents the group's work to the class. Homework[4] is given to consolidate learning and introduce the topic of next lesson.<br>As regards formative assessment, teacher evaluates students according to explicit criteria linked to learning outcomes[5] in order to give constructive feedbacks. Moreover, students are asked to assess their own improvements according to the criteria listed in the grids at the bottom of the worksheets[6].<br>Teacher monitors and scaffolds students during all the learning process. In particular helps students to answer questions either orally or in writing, using realia, posters and flashcards, providing prompts and extra time; he/she also allows them to use gestures or their native language[7]… |

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| **Materials, resources & tools** | - 1 card with the description of own role within the group per each student<br>- 1 worksheet per each student<br>- 1 tetrahedral die per each group[8]<br>- 1 laptop per each group<br>- An Excel spreadsheet<br>- Internet access<br>- A virtual wall on Padlet<br>- Interactive whiteboard<br>- Blackboard<br>- Teacher evaluation grid<br>- 1 worksheet with homework per each student<br>- Flashcards<br>- Posters |

[2] See Attachment_3. Different roles and/or kinds of linguistic structures must be planned for students with special needs in order to support full inclusion (e.g.: a student with a serious disability can participate only rolling the die).
[3] See https://padlet.com/.
[4] See Attachment_8 (and Attachment_9 for an example of differentiation for less able students).
[5] See Attachment_6.
[6] Assessment criteria are written in Past form. Student can understand them even though they haven't already studied this verb form.
[7] See Attachment_2 for some examples of flashcards and posters that can be used to scaffold use of language during the group activity. Posters, in particular, may have been realized in the previous lessons. Other examples of the language required are highlighted throughout the Lesson Plan.
[8] Paper dice have been constructed in the previous lessons starting from printed solid nets. See Attachment_1 for an example.

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| Activity | Activity aims | Activity procedure | Language aims | Interaction | Tools and materials | Timing |
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| **1** | - Present the problem.<br>- Recall useful vocabulary from previous lessons.<br>- Introduce the difference between theoretical and experimental probability. | **a.** Teacher holds up a tetrahedral die and asks students: "How can we determine if this die is a fair die?"<br>**b.** Teacher gives time to think and pair ideas.<br>**c.** Each pair shares its answer with the whole class.<br>**d.** Teacher writes students' ideas on the blackboard and stresses the importance of making "many" trials. Then asks students: "How many times do we have to roll the die to establish whether it is a fair die or not?"<br>**e.** Students brainstorm their ideas. | - Use of subject specific language.<br>- Use of language for hypothesizing and justifying. | ☑ Whole class<br>☐ Group work<br>☑ Pair work<br>☐ Individual work | - A tetrahedral die[9]<br>- Blackboard<br>- Flashcards and posters for scaffolding[10], if necessary | **20 minutes**<br>(5 "think",<br>5 "pair",<br>5 "share",<br>5 brainstorming) |
| **2** | - Make predic-tions.<br>- Collect, analyse and graphically interpret data.<br>- Connect experimental results to theoretical probability. | **a.** Teacher divides class into small groups, explains the task and checks the understanding.<br>**b.** Students take turn to roll the die and complete the worksheet.<br>**c.** Teacher walks around to support their work. | - Use of subject specific language.<br>- Use of superlatives.<br>- Use of language for hypothesizing and justifying. | ☐ Whole class<br>☑ Group work<br>☐ Pair work<br>☐ Individual work | - 1 tetrahedral die per each group<br>- Cards with the description of roles[11]<br>- Worksheets[12]<br>- 1 laptop per each group<br>- An Excel spreadsheet<br>- Flashcards and posters for scaffolding, if necessary<br>- Teacher evaluation grid[13] | **55 minutes**<br>(5 groups organization,<br>5 task explanation,<br>15 data collection,<br>30 completion of worksheet and graphical representation) |

[9] See Attachment_1.
[10] See Attachment_2.
[11] See Attachment_3.
[12] See Attachment_4 and Attachment_5.
[13] See Attachment_6.

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| **3** | - Share results.<br>- Connect experimental results to theoretical probability.<br>- Introduce the topic of next lesson. | **a.** Each group displays its graph on the virtual wall[14].<br>**b.** In turn, the spokesperson of each group summarizes the results of his/her group, justifying the choice of the type of graph.<br>**c.** Students discuss the questions: "What about putting all the results together?" "Does it make sense?" | - Use of subject specific language.<br>- Use of language for hypothesizing and justifying. | ☑ Whole class<br>☐ Group work<br>☐ Pair work<br>☐ Individual work | - 1 laptop per each group<br>- Internet access<br>- A virtual wall on Padlet<br>- Interactive whiteboard<br>- Flashcards and posters for scaffolding, if necessary | **35 minutes**<br>(5 organization of the virtual wall, 25 groups' exposures, 5 discussion) |
| **4** | - Evaluate own work. | **a.** Students evaluate own work. | | ☐ Whole class<br>☐ Group work<br>☐ Pair work<br>☑ Individual work | - Worksheets | **5 minutes** |
| **5** | - Consolidate learning. | **a.** Teacher assigns and explains homework. | - Use of subject specific language. | ☑ Whole class<br>☐ Group work<br>☐ Pair work<br>☐ Individual work | - Worksheets[15] | **5 minutes** |

[14] See Attachment_7 for an example of the result.
[15] See Attachment_8 and Attachment_9.