



## FaSMEd

Raising Achievement through  
Formative Assessment  
in Science and Mathematics  
Education



# Introducing probability with tablets and formative assessment lessons

<b>Subject:</b>	Mathematics
<b>Age of students:</b>	14 - 15 years
<b>Hardware:</b>	Tablets and teacher PC (both with internet), IWB
<b>Software:</b>	NetSupport School (connected classroom technology), OneNote for tablets
<b>Functionalities:</b>	Sending&displaying, processing&analysing
<b>Time:</b>	3 lessons of 1 hour
<b>FaSMEd partner:</b>	Ecole Normale Supérieure de Lyon
<b>Short Abstract:</b>	This 3-lesson sequence aims to define the notion of probability through a game situation. The results of instant surveys and the collection of students' work are used as the basis for classroom discussion and lesson notes.



## 1. Content

This sequence of lessons is a first introduction of the notion of probability aiming to define the probability of an elementary event in a sample space and to find methods to calculate it, starting from a mathematical game situation.

## 2. Activity

### 2.1 Aims

The target knowledge and competencies of this sequence consists in understanding and using elementary notions of probability and in calculating probability of simple events in the context of dice game.

### 2.2 Structure / Methodology

#### First session

The first session is devoted to the students' exploration of a problem: betting on the difference of two dice with six faces. Before starting, the teacher make a survey via tablet to collect the students' initial perceptions (Fig. 1).

Jeu : Différence des dés à six faces

On peut parier sur: 0; 1; 2; 3; 4; 5.

Je parie sur:



Fig. 1: First ideas collected and projected on the IWB

Then, students work in groups and each member of the group is required to work on his/her own tablet, with the common aim of coming to a shared conclusion: on which result they will bet and why? (See some examples of students' work in "probability-student work"). Finally, the teacher gathered the different students' proposals.

#### Second session

The second session opens with a debate about the different students' proposals that the teacher displays on the IWB (Fig. 2).



6	4	1
5	5	0
4	6	3
3	7	2
2	8	1
1	9	0
0	10	

On a pleins de chance de tomber sur 0,1,2 que sur 3,4,5

On remarque qu'il y a 21 combinaisons, 6 d'entres donne 0. Il reste 15 sur 6. Pour 5 nombres restants et qui ont moins de 6 combi.

Le résultat des 2 dés est au hasard donc je parle au hasard sur le résultat de la sommation des deux nombres.

6-5-1  
5-6-1  
6-3-1

) Résultat le plus probable

Fig. 2 The students' proposals to the initial question and teacher's remark

From the classroom discussion, two methods arise: do a large number of experiments and take the most frequent result (which comes up to the statistical definition of a probability) or list all the possible cases and consider the favourable ones (which comes up to the combinatorial definition of probability).

### Third session

In the last session, the teacher gets to the institutionalization of the definition of probability, starting from students' productions available at the IWB and integrating them into the lesson notes (see "probability-lesson notes"). This strategy allows him to validate students' work, in a perspective of formative assessment within the learning process.

## 2.3 Technology

These lessons have been implemented in a "tablet-classroom", that is to say a classroom in which each student has his/her own tablet and all tablets are part of a network.

The software NetSupport School is used in this sequence as the main connected classroom technology for classroom instruction, orchestration, monitoring and management. In particular, the teacher exploits the functionalities of the integrated student response system for proposing instant surveys in the classroom in order to create and support discussion. The teacher and the students are able to communicate through the network, by sending information, receiving feedback, collecting individual works from one or more tablet, and processing and analysing this data when displayed on the IWB.

The formative assessment strategies present in the teacher's intentions are reinforced and augmented by the use of technology. Connected classroom technologies plays a relevant role in the way the teacher orchestrates the classroom activity and guides the lesson.

NetSupport School allow him to collect in real-time the students' work, to foster discussion and debate in the classroom, and to use such data for constructing the lesson notes at the whiteboard. The functionalities of the IWB allow the teacher to comment and correct students' proposals, integrating them in the corpus of the lesson notes. Moreover, technology allows the teacher to enrich the students' *milieu* by sharing the different proposals and ideas produced by the students in the a-didactic phase of the dice game.



## 2.4 Aspects of Formative Assessment

### Establishing where the learners are in their learning

The teacher engineers effective classroom discussions that elicit evidence of student understanding and activates students as the owners of their own learning. These FA strategies are implemented essentially by proposing a survey in the classroom for collecting students' initial knowledge or conceptions through the available student response system, and by devolving a problem to students and asking them to write their answers on the tablet in order to collect and share them with the class. Discussing the proposals of one (or several) student(s) with the class by displaying them at the IWB is a FA strategy that aims to engage all students as owners of their learning but also to encourage each student to be a resource for others.

### Establishing where learners are going and what needs to be done to get them there

The fact that the lesson notes are not written in advance but they are built with the students in the classroom, by integrating and drawing on students' work and proposal, activates them as the owners of their own learning and clarifies the learning objectives. What they have to learn has been gradually built by the class as a group during the activity and the teacher follows the class' progression for get them towards the learning objectives.

### Use of feedback

The lesson has been built on the back and forth from student's work, debate and institutionalisation, and the IWB excerpt (see "probability-lesson notes") can be considered as an evidence of the teacher's use of feedback to inform and guide his teaching.

The debate in the classroom about some students' initial conceptions modifies the perception of random process. As an example, one of the groups decided that there is no preferred number to bet on because throwing dice is a random experience. The experiments and the debate make them aware of the possibility to do calculation on random phenomena. Confronting peers' ideas using the tablet network has permitted to institutionalise both a statistical and a geometrical approach to the notion of probability.

## 3. Further Information

The teacher wrote in his diary after the lesson:

*"The objective was to introduce the concept of probability starting from the students' conceptions, and to work with them about the double approach of this concept, as a frequentist approach or a geometrical one. The game about the difference of two dice was interesting because it caught them on the hop, by breaking an intuition of symmetry. For example, a student said that he bet on 3 because it's nice! The first survey I made with tablets convinced me of that!"*

To the question: "How did you detect students having difficulties and how did you manage?", his answer was:

*"First, I move along constantly in the classroom but also I watched the students' tablets screens with NetSupportSchool (which is the software of the network). Debate in the whole class, but also discussions with peers and individual help allow me to help directly these students."*



## 4. References

Panero, M. & Aldon, G. (2016). How teachers evolve their formative assessment practice when digital tools are involved in the classroom. *Digital Experience in Mathematics Education*, 2(1), 70-86. DOI : 10.1007/s40751-016-0012-x.

NetSupport School: <http://www.netsupportschool.com/>

For further information on this sequence (in French):

<https://ife.ens-lyon.fr/fasmed/spip.php?article16>