

# Designing a mathematics teaching: digital resources and evolutions of teachers' work

Ghislaine Gueudet  
CREAD, ESPE Bretagne; Rennes, France

# A focus on teachers' work with resources, why?

Resources are central in teachers' work, they intervene in this work in class and out-of-class.

The digital means have deeply modified the available resources, their design mode, their possible use, and the collective dimensions in teachers' work.



The screenshot shows the GeoGebra website homepage. At the top, there is a navigation bar with links for 'Referencia', 'Descarga', 'Inicio', 'Referencia', 'Eventos', and 'Comun'. The main content area features the GeoGebra logo and a 'Descarga' button. Below this, there is a list of features: 'Gráficos interactivos, álgebra y planillas dinámicas', 'Todos los niveles cubiertos, desde el básico escolar al universitario', 'Materiales de aprendizaje libres y gratuitos.', and 'Manual en Español completo y actualizado GeoGebra 3.2 Documento de Ayuda'. To the right, there is a small window showing a 3D cone and a 2D graph of a parabola. At the bottom, there are sections for 'Primeros Pasos' and 'Lista de Correo E-Mail'.

**GeoGebra**  
Software de matemática, libre, para enseñar y aprender

[Descarga](#)

- Gráficos interactivos, álgebra y planillas dinámicas
- Todos los niveles cubiertos, desde el básico escolar al universitario
- Materiales de aprendizaje libres y gratuitos.
- Manual en Español completo y actualizado [GeoGebra 3.2 Documento de Ayuda](#)

**Primeros Pasos**

1. Para empezar, recomendamos nuestros [Materiales Introdutorios](#)
2. **Cualquier consulta puede derivarse a nuestro [Foro de Usuarios](#)**

**Lista de Correo E-Mail**

Anotar el correo electrónico (e-mail) y pulsar Enter, basta para acceder a toda la información actualizada sobre GeoGebra.

## Two examples

1. Designing an inquiry-based teaching for Grade 9: the example of XXIst century alignment
2. Sesamath, a mathematics teachers' association in France

# Carnac alignments



A famous spot in Brittany...

# XXIst century alignment (Lebaud & Le Beller 2014)



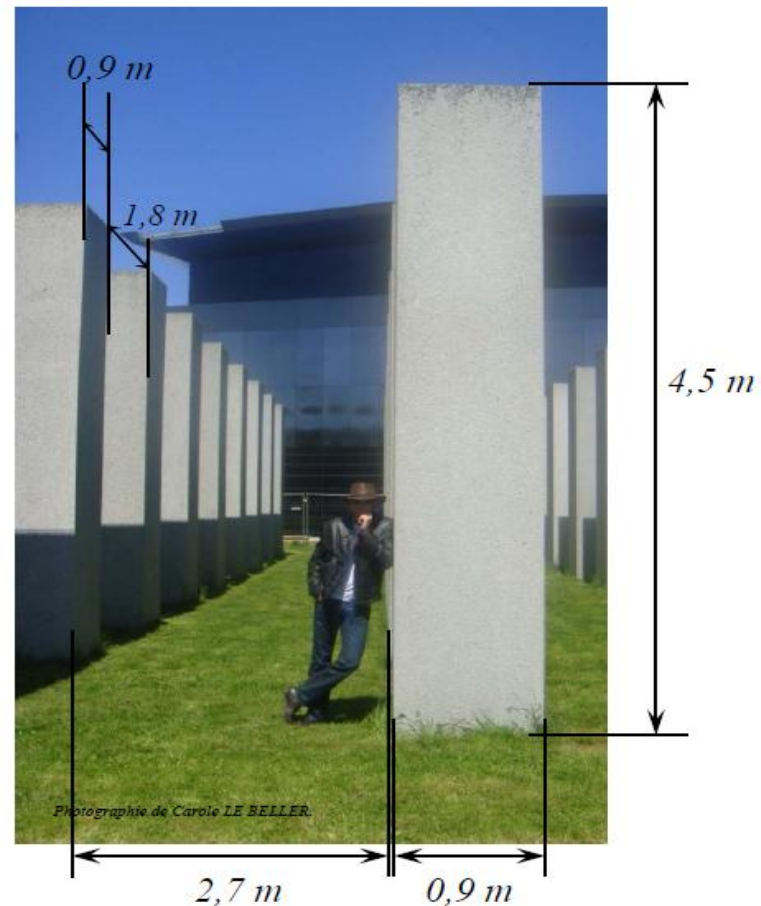
A sculpture from Aurélie Nemours, in Rennes  
Carole asks her grade 9 class:  
“What is the “XXIst century alignment” ?”

# XXIst century alignment, a teaching in 9 sessions

A search on the Internet, leading to questions raised by the students:

- Why 72 columns and not 3 ?
- Why did she choose these intervals between columns?
- Do the shadows join each other even at noon?

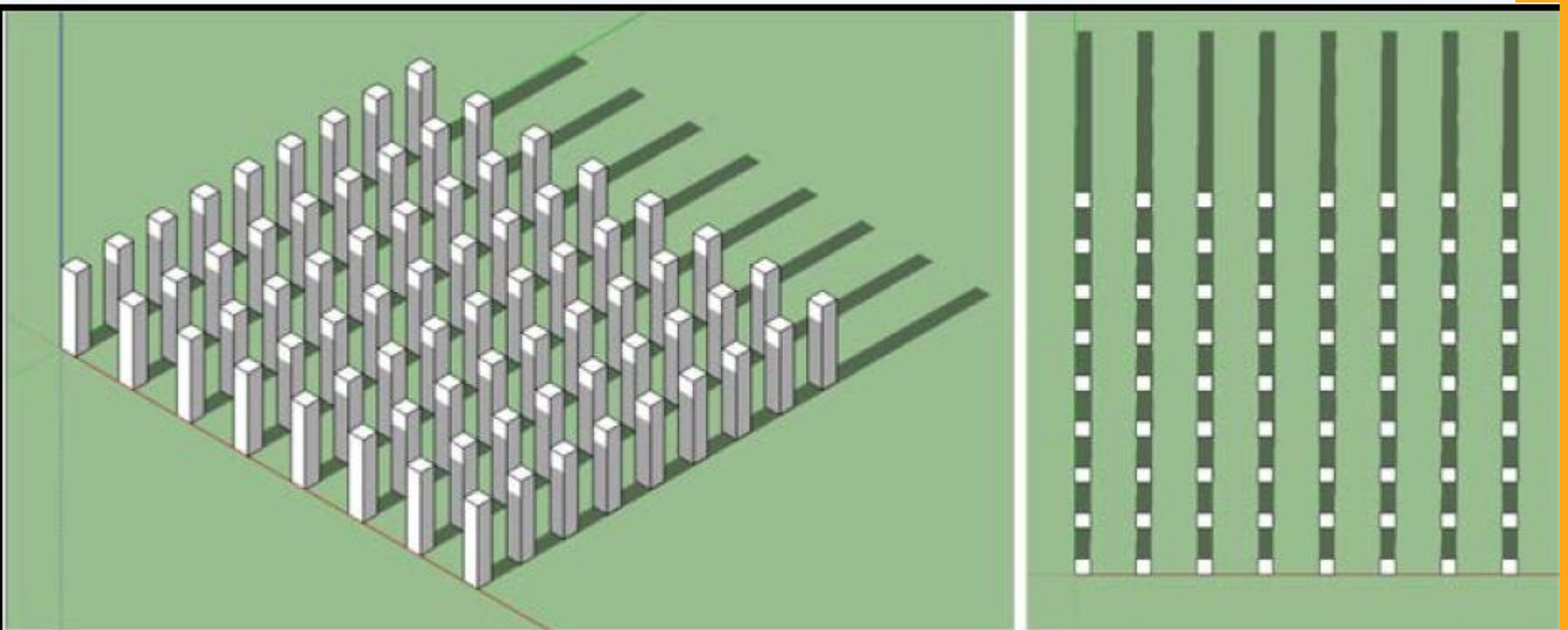
Starting point for an inquiry...





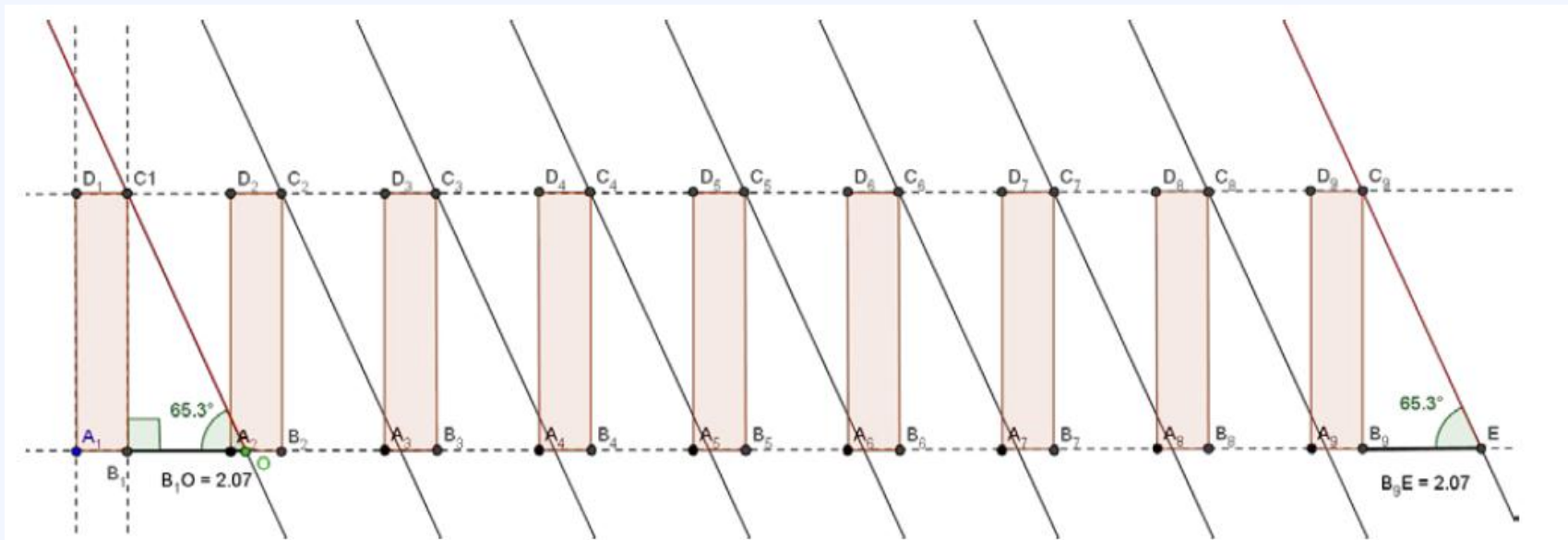
# XXIst century alignment, a teaching in 9 sessions

The students choose to use software, for a modelling of the alignment:  
Google sketchup...



# XXIst century alignments, a teaching in 9 sessions

The students choose to use software, for a modelling of the alignment: GeoGebra...

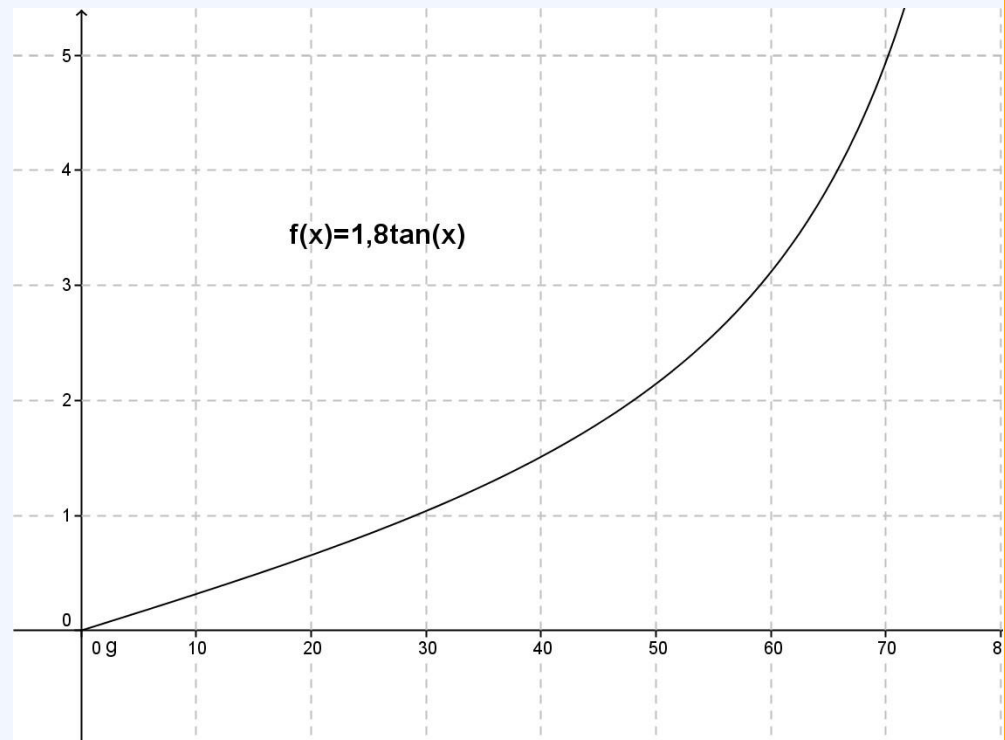




# XXIst century alignments, a teaching in 9 sessions

This situation lead them to work about:

- Proportionnality
- Functions
- Symmetry
- Angles and trigonometry....



L'ALIGNEMENT du XXI<sup>ème</sup> siècle

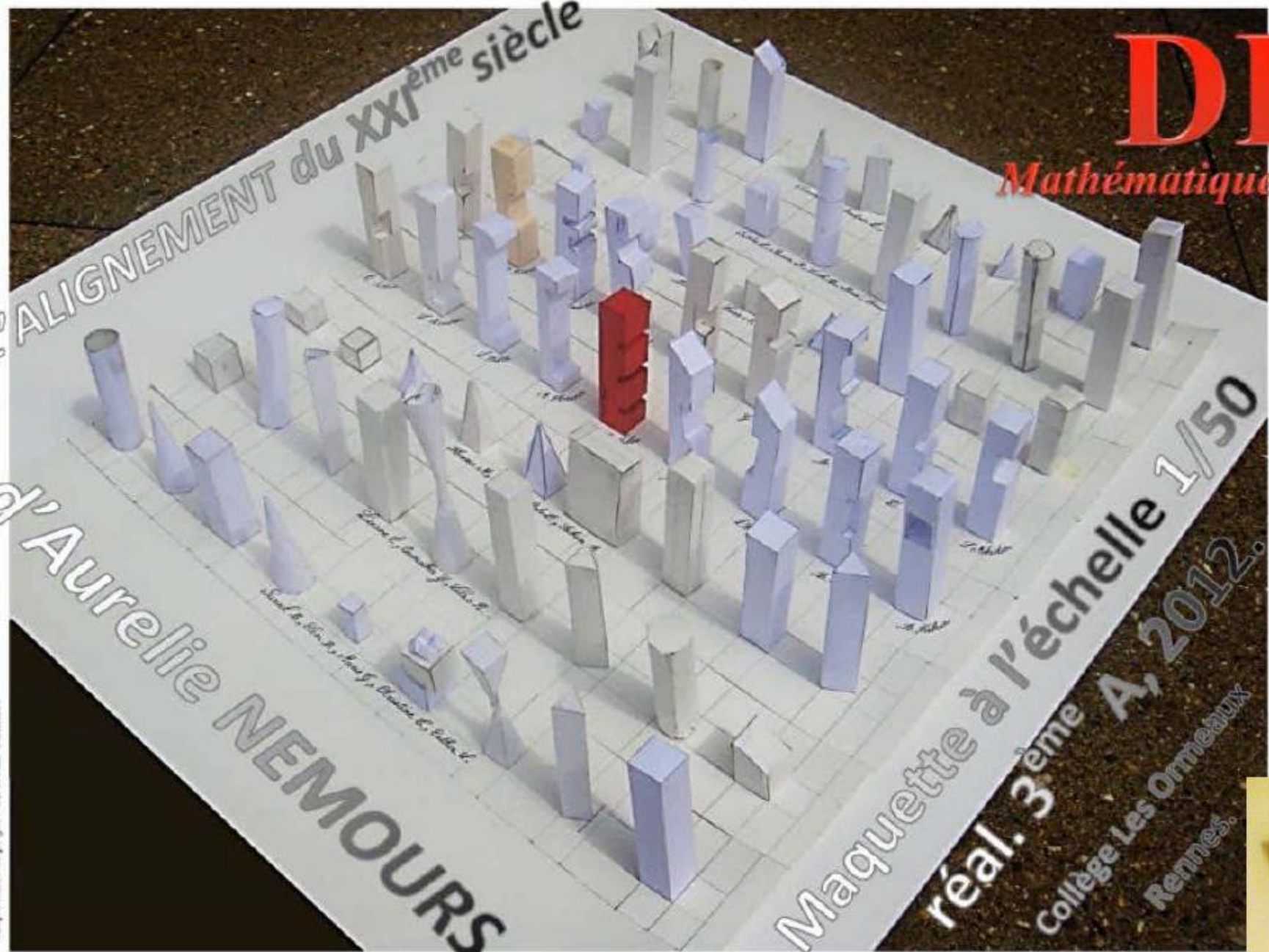
# DI

*Mathématiques*

d'Aurelie NEMOURS

Maquette à l'échelle 1/50  
réal. 3<sup>ème</sup> A, 2012.  
Collège Les Ormeaux  
Rennes.

Responsable du projet : Carole LE BELLER





# The Sesamath association

Created in 2001

- First common production: Mathenpoche, interactive exercises (2002-2003)
- An important step: producing textbooks (from 2005 to 2008). Paper textbooks, with a free digital version (Creative Commons Licence), and online complements
- In 2010: a complete virtual learning environment: LaboMEP.





# Mathenpoche, interactive exercises

(grade 4 to 10, access to students results for the teacher)

## Vocabulary and notations



Question # 1 : Complete the following sentence :

We know that -5 is the input associated with 1 in the function  $f$ .

Thus :  $f(\square) = \square$ .

### ALIZANT Gaspard (6e A)

|  |       |             |           |         |            |
|--|-------|-------------|-----------|---------|------------|
| 1 - 🌟 - Tables de multiplication               | 19/20 |             | ven 4 jan | 14 h 00 | 5 min 12 s |
| 2 - 🌟 - Quadricalc division                    | 27/30 |             | ven 4 jan | 14 h 05 | 4 min 32 s |
| 3 - 🌟 - Méthode 2 p 29                         |       |             | ven 4 jan | 14 h 10 | 13 s       |
| 4 - 🌟 - Vocabulaire sur la division            | 3/10  |             | sam 5 jan | 09 h 30 | 1 min 43 s |
| 4 - 🌟 - Vocabulaire sur la division            | 7/10  |             | sam 5 jan | 09 h 32 | 3 min 43 s |
| 4 - 🌟 - Vocabulaire sur la division            | 10/10 |             | sam 5 jan | 09 h 36 | 5 min 40 s |
| 5 - 🌟 - Division posée classique (diviseur<10) |       |             | ven 4 jan | 14 h 14 | 5 min 28 s |
| 6 - 🌟 - Division posée classique (diviseur<10) | 9/10  |             | ven 4 jan | 14 h 19 | 3 min 20 s |
| 7 - 🌟 - Attention aux zéros !                  | 1/2   | Cliquez ici | ven 4 jan | 18 h 52 | 2 min 12 s |
| 8 - 🌟 - Petit défi                             | 0/1   |             | ven 4 jan | 18 h 54 | 15 s       |
| 9 - 🌟 - Exercice 4 p 14                        |       |             | sam 5 jan | 09 h 42 | 15 s       |

# E-textbooks (grade 6 to 10)

Vous êtes connecté en tant que professeur - [Cliquez ici](#) pour passer en mode élève (qui ne comprend pas de corrections)

Sommaire

N.R.

M1

N2

N3

N4

D1

D2

G1

G2

G3

G4

G5

M1

M2

Méth.

Corr.

Propriétés

Lexique

Formulaire

## Activités de découverte

### Activité 1 : Somme des angles d'un triangle (découverte)

- Trace deux triangles quelconques de formes différentes et mesure leurs angles à l'aide d'un rapporteur.
- Trace un triangle particulier (isocèle, rectangle ou équilatéral) puis mesure ses angles à l'aide d'un rapporteur.
- Pour chaque triangle tracé, additionne les mesures des trois angles. Que remarques-tu ?
- Essaie de tracer un triangle dont la somme des angles est égale à  $220^\circ$ . Que remarques-tu ?



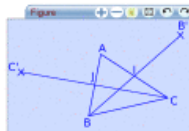
### Activité 2 : Somme des angles d'un triangle (démonstration)

- Avec TracenPoche, place trois points A, B et C.

En utilisant le bouton construis le triangle ABC.

À l'aide du bouton place les points I et J, milieux respectifs de [AC] et [AB].

En utilisant le bouton construis le point C', symétrique de C par rapport à J et enfin le point B', symétrique de B par rapport à I.



- Dans la fenêtre Analyse, recopie :

Analyse  
A,B',C' alignés ?

Appuie sur la touche F9. Quelle est la réponse ? Nous allons démontrer cette réponse.

- En utilisant une propriété sur la symétrie centrale, démontre que les droites [AB'] et [AC'] sont parallèles à la droite (BC). Dédus-en que les points C', A et B' sont alignés. Trace alors la droite (B'C').

- On va maintenant s'intéresser aux angles. Dans la fenêtre Analyse, recopie :

Analyse  
angle(ABC)=  
angle(BAC')=

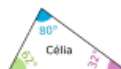
Appuie sur la touche F9 puis déplace les points A, B et C. Que remarques-tu ?

Nous allons démontrer ce que TracenPoche affirme.

- En utilisant la symétrie de centre J, démontre que  $\widehat{ABC} = \widehat{BAC'}$  puis en utilisant la symétrie de centre I, démontre que  $\widehat{ACB} = \widehat{CAB'}$ .

- Dédus-en que  $\widehat{BAC} + \widehat{ABC} + \widehat{ACB} = 180^\circ$ .

- Application : Marco, Célia et Romain ont tracé chacun un triangle et ont mesuré leurs angles. Sans utiliser de rapporteur, indique si certains se sont trompés :



### Activité 3 : Hasardons-nous à construire un triangle

#### Sés Compléments

Cliquer sur l'icône correspondante pour accéder aux compléments indiqués ci-dessous.

#### C Correction

- Acti déplacer le point C ou C'. Lorsque le triangle est formé, la somme des trois angles apparaît.

Acti

C. Quelles mesures sont communes aux triangles HSI et HSU ? Combien y en a-t-il ?

- Trois mesures permettent-elles toujours de construire un triangle unique ? Justifie.



# Labo MEP

**Un laboratoire pour les TICE**

Classes

- Exercices interactifs
- Animations interactives
- Tests diagnostiques
- Exercices non interactifs

Manuel 5e - 2006

Manuel 4e - 2007

Cahiers 4e - 2007

Manuel 3e - 2008

Cahiers 3e - 2008

**Manuel 6e - 2009**

- Nombres entiers et décimaux
- Opérations et nombres entiers
- Nombres fractions
- Opérations et décimaux
- Écriture fractionnaire
- Proportionnalité
- Tableaux et graphiques
- Calcul mental et réfléchi
- Cercles, distance
- Angles droits
- Symétrie axiale
- Espace
- Axes de symétrie
- Angles
- Aires et périmètres
- Volumes
- Corrections des exercices À toi de jouer
- Lexique
- Formulaire

Cahiers 6e - 2009

Ressources partagées

Accueil Nouvelle séance

Nouvelle sous-séance Enregistrer sous Enregistrer Paramétrer

Sous-séance 1

- Ressources
- Elèves

Mes groupes

Mes ressources

Mes séances

- Mes séances
  - Seance Laetitia
  - Rival 1
  - PE symetrie
  - Boulier CE2
  - Test algebre
  - Revenir sur le rôle de l

**Grade 6 textbook**

**Shared resources**

Affichage normal | Élèves de l'établissement | Options | Contacts et signalements | À propos | Aide

# Use of Sesamath resources, some figures

(end 2012)

- More than 18 000 teachers inscribed on Sesaprof  
(around 48 000 maths teachers in France)
- More than 15 000 000 connexions on Sesamath websites
- More than 1 000 000 students inscribed on LaboMEP



# Outline

- 0) Examples
- 1) Questions about teachers' resources
- 2) Investigating teachers' resources
- 3) Results
- 4) Digital resources and teacher education

# 1. What is a resource for the mathematics teacher?

Textbooks, official curriculum, software, websites certainly are resources

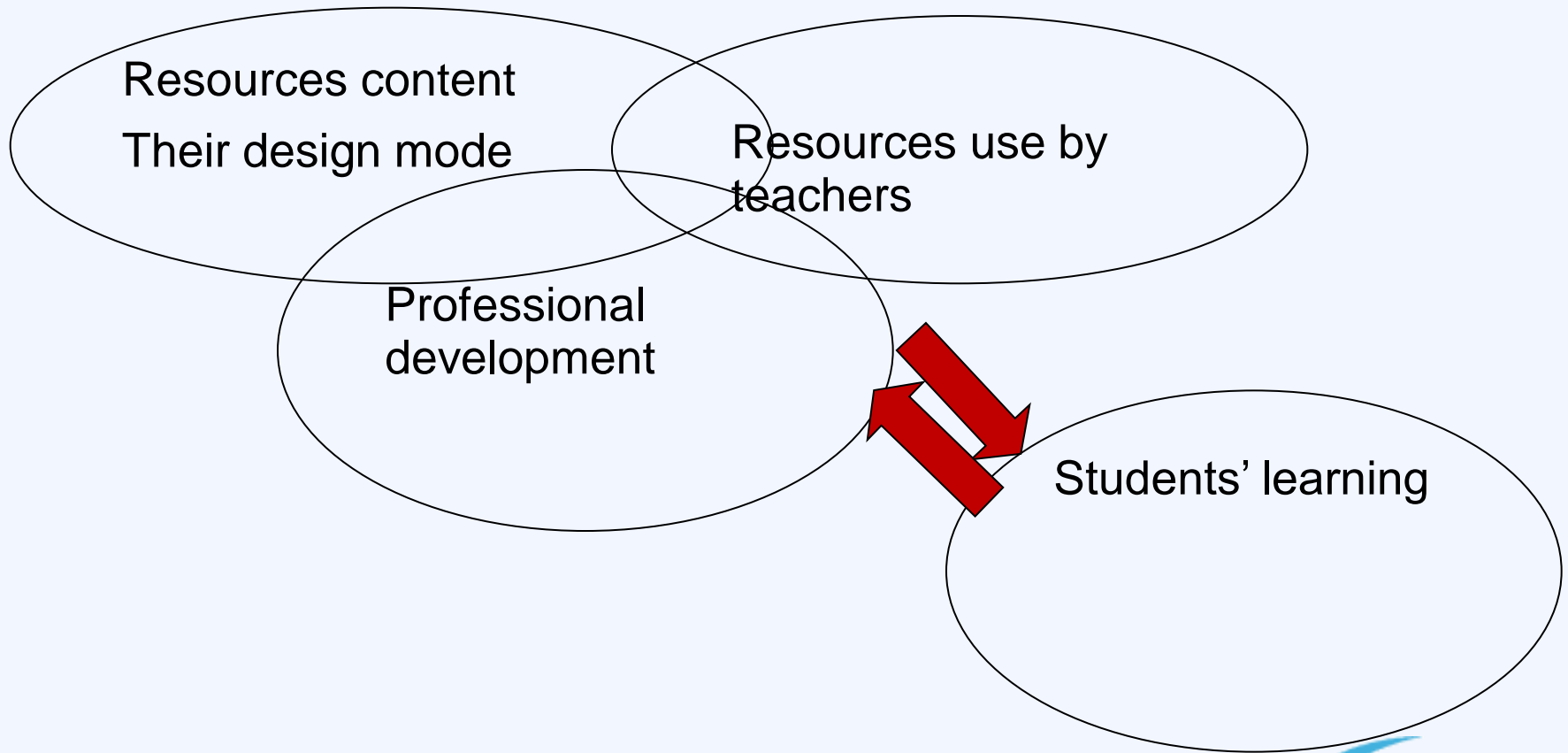
Some resources are designed for teaching, and others not: e.g. XXIst century alignment

Some resources are material, and others not: a file sent by a colleague is a material resource; but the discussion with the same colleague is also a resource

Adler (2000): **a resource is anything likely to re-source the teacher's practice**



# Different kinds of questions about resources



## Questions about resources: their content, their features, their design mode

- How are teaching resources designed: by who, with which objectives, which target public?
- How can we transmit a lesson, share it with colleagues? If we give too much details, they will not read it... If we do not give enough details, they will not understand it...
- How can we define, and assess, the quality of a teaching resource?



## Questions about resources use, and professional development

- Which resources do mathematics teachers use? How do they choose them?
- How do teachers modify the resources they choose, how do they combine them, to create their own resources?
- Do some resources lead to evolutions of the teachers practices?
- Do teachers work collaboratively with resources? Do some resources foster teachers' collective work?

**How does the development of digital resources influence the answers to the previous questions?**



## 2. Investigating teachers' resources: research in mathematics education with the documentational approach

General perspective: the teacher is a designer of his/her teaching

The teacher draws on sets of resources: looks for resources, chooses some resources, transforms them, set them up in class etc.: *the teacher's documentation work*

- The features of the resources influence the teacher's work;
- The teacher's professional knowledge influences the way he/she uses the resources, transforms them etc.

# Research in mathematics education with the documentational approach

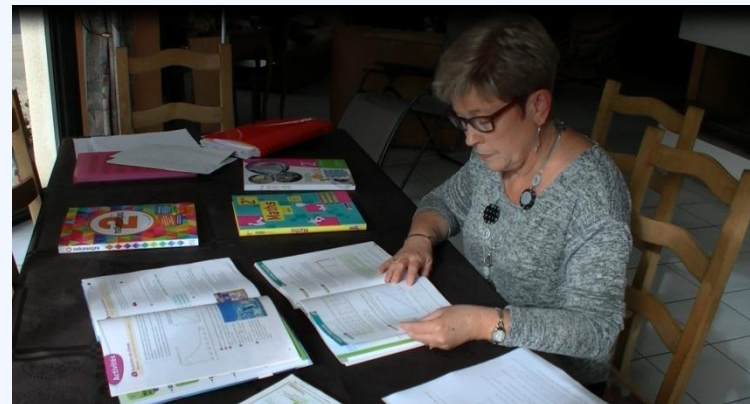
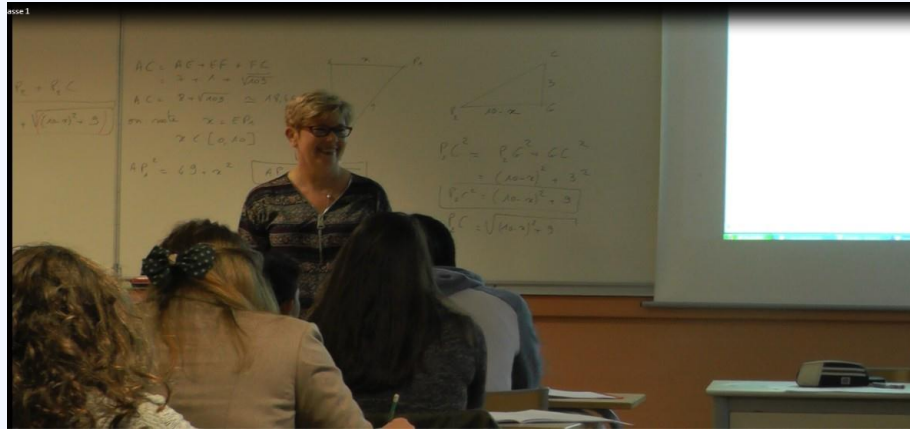
Along this work, the teacher develops a structured *system of resources*.

New questions:

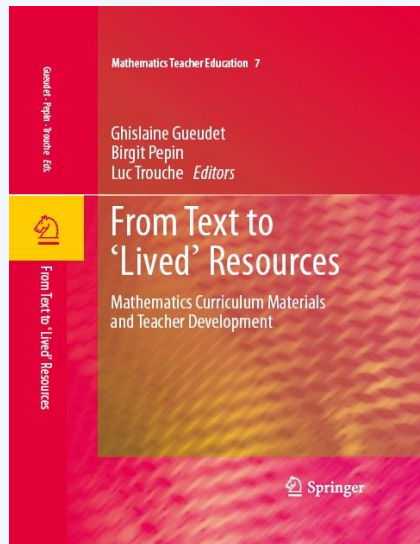
- What is the content, structure, of mathematics teachers resources systems?
- How is a new resource integrated in the system?
- How do the systems evolve with the development of digital resources?
- In teachers' communities, how do the individual and the collective resources systems interact?

# Research in mathematics education with the documentational approach

A need to follow teachers in class and out-of-class, over long periods, to collect their resources. Individual teachers, and communities of teachers.



# A research program started in 2007



Gueudet, Pepin & Trouche (ed. 2012)  
Adler, Cobb & Visnovska, Drijvers,  
Kieran, Solares & Tanguay, Mariotti  
& Maracci, Remillard, Ruthven,  
Schmidt, Trigueros & Lozano,  
Winsløw...



A national research project started  
in 2014:

Investigating the resources of  
teachers in mathematics,  
physics, English, technology



# 3. Results

## Example 1: Carole and the alignments

In Carole's system of resources:

- Different software, she is familiar with technology, develops her own website
- Many resources linked with space geometry

Math @ctvités mouvement Math @ctvités 3D Math @ctvités 3D (suite) Math @ctvités 3D

Construire le patron de la boîte de rangement du flexacube composée du couvercle et du fond

**BOITE du FLEXACUBE**

Couvercle :

4,3 cm

17,15 cm

4,4 cm

FLEXACUBE

Et si cela est difficile : télécharger plus bas les fichiers au format pdf, imprimer 4 feuilles de 21x29.7 cm. Plier, coller et assembler les 8 cubes en suivant les indications ci-après. Le patron de la boîte (à télécharger) est en pdf.

**D**écoupage, pliage, collage et assemblage :

- 1. Découper. Effacer les traits inutiles. Avec une pointe sèche de colle.
- 2. Assembler les cubes en mettant du ruban adhésif transparent le long des arêtes.
- 3. Coller les grilles, prédessinées et prédécoupées 2 par 2 carrés cotés de 4,4 cm.

Et si l'assemblage à partir de ce plan en perspective vous semble difficile à comprendre, voici des aides en images de l'assemblage du FLEXACUBE :

AIDE en images de l'assemblage du FLEXACUBE :

(Cliquer-gauche sur l'animation pour afficher les explications. Le survol de la souris fera diffuser les images.)

### 25- Fractale étoile de Kepler by Carole Le Beller



Background color:

3D technology : Auto | WebGL | Flash | JS





## 3. Results

### Example 1: Carole and the alignments

Importance of collective dimensions:

- Carole already worked previously with the fine arts teacher in her school
- She participates in a group about inquiry-based teaching

All these factors contribute to the integration of new resources in her system: the alignments + Google Sketchup etc.



## Example 2: Sesamath

Investigating the design of the grade 10 e-textbook (Sabra & Trouche 2011).

Distant collaboration of a group of 14 teachers, between 2009 and 2013.

Using: the official curriculum; the usual courses of the different members, a distant platform.

Initial intention: choose a list of keywords, corresponding to elementary skills (for example: “Represent graphically the square function” ). Characterise with these keywords pieces of course; interactive exercises, problems etc.

For the teachers using the e-textbook, this should permit to build many different coherent paths – the pieces of course, and the exercises, are seen as bricks that the teacher will arrange to build his/her course.

## Example 2: Sesamath

**Damien** : I think that the course belongs to a precise chapter with three different sections. On the other hand, for the exercises we have to mix up everything.

**Michel** : But we need to choose exercises according to the progression. We can perhaps try to make something clear and simple for the teacher, concerning the course, the introductory activities and the basic exercises.

**Sandrine** : We need to have a **kernel** in each chapter, with the techniques of this precise chapter. In this kernel, we can not mix up things.

Finally: choice of a kernel in each chapter, with the introductory activities, the course, the basic exercises, corresponding to the same techniques. The more complex exercises can correspond to different keywords, they can be associated to different chapters.

Influence of the authors own courses...



## Results about resources and their design mode

The design modes have deeply evolved with digital means.

More and more teachers design and publish on websites their own resources; the collaborative design of resources by groups of teachers is more and more important (e.g. Sesamath)

Some teachers look for “ready-made” resources; but there is also a need for “meta-resources”, helping teachers to design and share resources.

(Fischer & Ostwald 2005)

The design-use articulation has evolved: the user of a resource can post a comment on a website, and the author can modify the resource accordingly.



## Results about resources: quality issues

The evolution of design modes requires an assessment of the resources quality

*How to define the quality of a teaching resource?*

Ergonomy ;

Mathematics content (correct- corresponding to the official curriculum – likely to foster a rich mathematical activity of the students) ;

Possibilities of modification by the user, preserving the coherence of the resource

*Who assesses quality?*

In the Intergeo project (Trgalová et al., 2010, resources around the use of dynamic geometry): a questionnaire for users. The quality of a resource depends on the user's precise objectives.



## Results about resources use

*Use of resources by mathematics teachers in France*

(no quantitative study – hypotheses, from several case studies)

Textbooks are still central, in teachers' resources systems

The class textbook (shared with the students) is used for:

- Choosing the structure of the course (“progression”)
- Giving homework

It is more and more often associated with a digital version (pdf), projected in class by the teachers.

The publishers propose online complements, and sophisticated e-textbooks but these are not much used yet.



# Results, about resources use

The use of software: dynamic geometry, spreadsheets, scientific computation has developed with institutional incitation (for example, a teaching concerning algorithms from grade 10 to 12).

The textbooks integrated this use of software, by proposing:

- in the paper version exercises and problems
- in the online complements digital files

Ch4\_TP5 [Mode protégé] - Microsoft Excel

Fichier Accueil Insertion Mise en page Formules Données Révision Affichage

Mode protégé Ce fichier provient d'un emplacement Internet et peut présenter un risque de sécurité. Cliquez pour plus d'informations. Activer la modification

D1 Mesure de l'épaisseur d'un cheveu par diffraction

|    |  |   |       |       |     |      |      |      |      |
|----|--|---|-------|-------|-----|------|------|------|------|
| 1  | Chapitre 4 - TP 5                        | Mesure de l'épaisseur d'un cheveu par diffraction |       |       |     |      |      |      |      |
| 2  |  |   |       |       |     |      |      |      |      |
| 3  |  |   |       |       |     |      |      |      |      |
| 4  | Diamètre du fil $d$ (en mm)              | 0,08  | 0,056 | 0,072 | 0,1 | 0,12 | 0,16 | 0,18 | 0,26 |
| 5  | Largeur de la tache centrale $L$ (en cm) | 1,3   | 1,9   | 1,5   | 1   | 0,8  | 0,6  | 0,5  | 0,3  |
| 6  |  |   |       |       |     |      |      |      |      |
| 7  |  |   |       |       |     |      |      |      |      |
| 8  |  |   |       |       |     |      |      |      |      |
| 9  |  |   |       |       |     |      |      |      |      |
| 10 |  |   |       |       |     |      |      |      |      |
| 11 |  |   |       |       |     |      |      |      |      |
| 12 |  |   |       |       |     |      |      |      |      |
| 13 |  |   |       |       |     |      |      |      |      |
| 14 |  |   |       |       |     |      |      |      |      |
| 15 |  |   |       |       |     |      |      |      |      |
| 16 |  |   |       |       |     |      |      |      |      |
| 17 |  |   |       |       |     |      |      |      |      |
| 18 |  |   |       |       |     |      |      |      |      |
| 19 |  |   |       |       |     |      |      |      |      |
| 20 |  |   |       |       |     |      |      |      |      |
| 21 |  |   |       |       |     |      |      |      |      |
| 22 |  |   |       |       |     |      |      |      |      |
| 23 |  |   |       |       |     |      |      |      |      |
| 24 |  |   |       |       |     |      |      |      |      |
| 25 |  |   |       |       |     |      |      |      |      |
| 26 |  |   |       |       |     |      |      |      |      |
| 27 |  |   |       |       |     |      |      |      |      |
| 28 |  |   |       |       |     |      |      |      |      |

Questions 1 et 2 : voir les quatre autres feuilles du classeur

Données Question 1 Question 2.a Question 2.b Question 2.d



## Results, about resources use

Use of many other websites proposing activities with various kinds of software: institutional websites, associations (like Sesamath), personal websites etc.

In “complex tasks” (inquiry), students search for information on the Internet.

The screenshot shows a Mozilla Firefox browser window displaying Google Maps for 'lac chambon'. The search bar contains 'lac chambon' and the search button says 'Recherche Google Maps'. The map shows a lake with a red outline. On the left, there is a sidebar with the title 'Outil de mesure des distances' and a search bar. Below the search bar, there are radio buttons for 'Métrique' (selected) and 'Anglo-saxon'. The 'Distance totale :' section is empty. At the bottom of the sidebar, there are buttons for 'Supprimer le dernier point' and 'Réinitialiser'. In the top right corner of the browser window, there is a red box around the 'Nouveau !!' button. In the bottom right corner of the map area, there is a red box around the scale bar showing '200 m' and '1000 pieds'. A red box on the right side of the map contains the text 'Pour installer le logiciel'. A red box on the left side of the map contains the text 'Pour utiliser le logiciel'.

## 4. Resources and teacher education

Documentation work contributes to professional development, and can lead to evolutions of practice (in particular: collective documentation work).

Consequence: proposition of in-service teacher education programs, organised around the design of lessons by teams of teachers.

Principle present in the Japanese lesson studies.

*Is it possible to use digital means to organise such teacher education programs (integrating a part of distant work)?*

# Resources and teacher education

Pairform@nce (Gueudet & Trouche 2011)

- ✓ A national teacher education project, concerning all disciplinary fields, primary and secondary school ;
- ✓ *Integration of ICT* ;
- ✓ Design of *training paths*, providing the structure of training device to be carried out across the country;
- ✓ These training device are *blended*, using a distant platform; they are grounded in *collaborative lessons design*

The screenshot shows the Pairform@nce website interface. The header includes the logo 'pairFORM@NCE formation collaborative en ligne' and navigation links for 'Ressources', 'FAQ', 'Forums nationaux', and 'Support'. An Intel logo is also present. The main content area is titled 'Bienvenue dans l'espace documentaire' and includes a search bar, a navigation menu on the left, and a section for 'Offre de parcours de formation' with detailed text about training paths and a calendar for June 2010.

pairFORM@NCE formation collaborative en ligne

Ressources FAQ Forums nationaux Support

intel

Bienvenue dans l'espace documentaire

Accueil Pairform@nce > Offre de parcours

Offre de parcours de formation

Les parcours de formation sont des scénarios/canevas proposant des activités et des ressources pour se former.

Ils sont structurés selon une démarche pédagogique de formation-action qui privilégie le travail collaboratif entre pairs, la conception collective d'activités pédagogiques expérimentées en classe et l'activité en réseau.

• Mutualisation de contenu de formation

Pairform@nce s'inscrit dans une démarche qualité. Les parcours de formation une fois terminés sont soumis à expertise en vu de leur qualification.

C'est à la suite de ce processus que les parcours qualifiés sont mis à la disposition de la communauté éducative.

• Déclinaison académique

Les parcours proposés dans le catalogue national constituent des offres de formation que les académies peuvent adapter à leurs contextes.

Elles les traduisent en actions de formation et les proposent aux enseignants dans le cadre des Plans académiques de formation ou des Plans départementaux de formation pour le premier degré.

Les formations peuvent être mises en oeuvre dans les académies, les circonscriptions, les bassins ou encore dans les établissements par les équipes de la formation continue.

Dernière mise à jour : lundi 8 mars 2010, 17:02

Zoom sur ...

Réseaux académiques

Plan ENR

Espaces collaboratifs

Calendrier

juin 2010

| Di | Lu | Ma | Me | Je | Ve | Sa |
|----|----|----|----|----|----|----|
|    | 1  | 2  | 3  | 4  | 5  |    |
| 6  | 7  | 8  | 9  | 10 | 11 | 12 |
| 13 | 14 | 15 | 16 | 17 | 18 | 19 |
| 20 | 21 | 22 | 23 | 24 | 25 | 26 |
| 27 | 28 | 29 | 30 |    |    |    |

Les plates-formes de formation

## Resources and teacher education

Example of a training about “inquiry in mathematics with dynamic geometry”

Three days in presence, and distant work. Design of lessons by teams of teachers, experiments in class.

An interesting training mode, when the trainers are also the designers of the “training path”.

Two difficulties:

- Difficulties with the distant collaboration of teachers – they prefer face-to-face meeting. The local organisation did not permit the inscription of groups of teachers from the same school.
- Difficulties for trainers who did not design the training path to use it as a resource to build their own training.

## Resources and teacher education

Teaching and Training with Digital Resources in Mathematics (eFAN Maths), a MOOC starting in November 2014

[https://www.france-universite-numerique-mooc.fr/courses/ENSCachan/20007/Trimestre\\_3\\_2014/about](https://www.france-universite-numerique-mooc.fr/courses/ENSCachan/20007/Trimestre_3_2014/about)

A work over 4 weeks (4h each week)

Week 1: Instruments


Week 2 : Analysing students activity

Week 3 : Analysing the teacher's role

Week 4 : Quality of resources



Teams of participants propose teaching projects, integrating digital resources.

Teams from the same school; the trainers are the designers... 

## Conclusion: a rich and complex situation

- A profusion of digital resources, but perhaps missing resources for teachers, for teacher trainers (*which resources are needed?*)
- Digital resources should allow adaptations for the user; constant improvement by the authors, integrating users' remarks. But are the remarks integrated (Trgalova & Jahn 2013) ?
- E-textbooks offering possibilities of adaptations, different paths: *more expertise required*, for the user of an e-textbook
- Need for more in-service training, and more research!

***Thank you***

***Tak***

***Merci***





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