

Pepite : helping teachers diagnose students' algebra competencies

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Overview

- **Pepite project**
 - ◆ Educational foundations (Grugeon 95)
 - ◆ Pepite software (Jean 2000, Prévité 2002)
 - ◆ Pepite testings (Delozanne & al 2002)
 - ◆ Scenarios of use
- **Results and questions**

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Pedagogical Basic Assumptions

- **Students' answers show coherences in their reasoning**
- **It is possible to analyse their answers to identify the coherences the students have built (correct, partial, inappropriate)**
- **Identifying those coherences would help teachers to give appropriate tasks to destabilize them (if inappropriate) and to make them evolve**

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Design assumptions

- **Computers can help teachers both**
 - ◆ **in identifying competences**
 - "Pépites" (nuggets)
 - ◆ **in giving appropriate tasks to enhance learning and understanding**
 - building "Lingot", (ingot)
- **Three classes of end users**
 - ◆ **Students**
 - usual user-centered design techniques (Human Computer Interaction)
 - task analysis based on educational research
 - ◆ **Teachers & Educational researchers**
 - new usage patterns to be invented
 - participatory design (researchers and teachers)

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Pépîte Project

- **Objective**
 - ◆ To help teachers diagnose student's competence in algebra in order to better regulate learning
- **Multidisciplinary project**
 - ◆ Educational research in mathematics (DIDIREM)
 - a multidimensional model of algebraic competence
 - a paper and pencil diagnostic tool
 - ◆ Computer science research (LIUM)
 - (partial) automation of this paper and pencil diagnostic tool
 - ◆ Together
 - Usage
 - Developing awareness about diagnosis algebra competencies
 - Modifying teaching approach to algebra
 - Watching teachers using Pépîte in classrooms
 - with ergonomics (J. Rogalski, CNRS et Paris 8)
 - Spreading research results
 - Modelisation
 - Algebraic tasks, diagnosis tasks (teaching scenarios)

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A paper&pencil diagnosis tool

(Grugéon 1995)

- A multidimensional model of competence
 - ◆ Mastered skills, meaning of letters, processing algebraic expressions, translation between representations, type of justification
- A set of Paper & pencil exercises and an analysis grid
 - ◆ 3 kinds of problems:
 - Technical (generational and transformational), modelling, interpreting skills
 - ◆ Analysis grid derived from the model of competence
 - To characterize the exercises and to characterize usual students answers
- Students' profiles
 - ◆ quantitative description
 - Success rates on mastered skills
 - ◆ qualitative description
 - Meaning of letters, processing algebraic expressions, translation between representations, type of rationality
 - ◆ description of flexibility between representations
 - Diagram

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Diagnosing method

- **Objective :**
 - ◆ To situate the student in the model of competence
 - ◆ By identifying coherences in students' answers (not only errors) in order to :
 - Develop accurate conceptions
 - Destabilize inaccurate conceptions
- **Diagnosing task for the teacher :**
 - ◆ To make students having the test
 - ◆ To interpret first each student's answer
 - To code the student answers to each exercice
 - ⇒ fine description
 - ◆ To built the student's profile
 - To analyse globally the coding
 - ⇒ overview

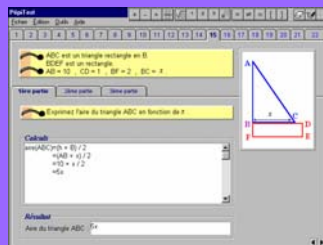
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Pépité software

End-users:

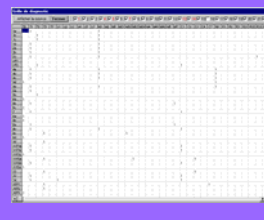
Students

PÉPITEST



Teachers
Students ?

PÉPIDIAG



PÉPIPROF



Coding of the data

Coding correction

Transversal analysis

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Pepite testings

Context	Situations	Users	Numbers	Data
Testing students	Classrooms	Students	200	Answers, questionnaires, observations, research reports
Educational research	Prototypes of profiles	Researchers	5	Lists of usability problems, modification in didactic modelling
Teachers training	Studying 1 student, students competencies	Pre & in-service teachers	140	Questionnaires & observations
Pilot session	Individual support, evaluation of their students	Teachers	6	Observations, audio-tapes, interviews, questionnaires
Spontaneous uses	Classroom, teachers training	Teachers and teachers trainers	11	Report

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Scenarios of uses

- **A priori scenario written by designers**
 - ◆ diagnosing students to regulate learning
- **Observed scenarios**
 - ◆ Assessment before an examination
 - ◆ Learning activities : socio-cognitive conflict
 - Whole class
 - Working by pair
 - ◆ Help in making teacher's mind for in orientation process
- **A posteriori scenarios written by teachers**
 - ◆ at the beginning of the year
 - Design of a "Class geography"
 - Reviewing prerequisites
 - ◆ keeping track of students evolution to be used later

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What teachers like ?

- **Pepitest**
 - ◆ shows competences that they were not aware of
 - ◆ gives them ideas of exercises they were not used to ask
- **In training sessions**
 - ◆ Coding software
- **Pepite**
 - ◆ makes them more confident with their poor students
 - ◆ helps them to install new relationship with their students' errors
 - ◆ helps them to understand the new official program in mathematics
 - ◆ increases students confidence in their teacher's competence

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What teachers do not like ?

- **difficulties with using computers**
- **time consuming (1 H1/2 test, 1/4 H analysis)**
- **the cognitive profile and “didactical jargon”**
- **distorting mirror of their teaching**
- **mistrust of their understanding of algebra teaching**
- **mistrust of their professional competence**

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What teachers ask for ?

- remediation proposals according to student's profile
- a feedback for the students given by the software
- possibility to modify the test, to adapt it
- training in using the model of competence and algebra teaching
- a "cognitive geography" for the whole class
- printing facilities for paper and pencil work
- an editor for algebraic expressions

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Future work on diagnosis

- A more open software
 - ◆ Adapted to
 - Several tests
 - Several types of users (teachers, students, researchers)
 - Several diagnosis process according to uses (
 - static/adaptative
 - Automatic/assisted
 - ◆ By
 - Modelling diagnosis method in order to generate diagnosis tools from patterns
 - Better analysing open answers
- Teaching strategies adapted to each profile
 - ◆ Amico
 - ◆ Envidap
- A diagnostic for students

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Key elements in Pépité

- **An iterative methodology which enables us**
 - ◆ to work in a pluridisciplinary context and in classrooms
 - ◆ to build an “instrument” for teachers (Rabardel)
 - Instrumentalisation (artefact evolution)
 - Instrumentation (teacher evolution)
 - ◆ to spread research results
- **A diagnostic assistant in order to help teachers improving their teaching of algebra**

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Web sites

Download and research documents

<http://pepité.univ-lemans.fr>

Documents for teachers (in french)

<http://maths.creteil.iufm>

(formation continue, la compétence algébrique du collège au lycée)