Aplusix: Algebra Learning Assistant

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Demonstration at the Kaleidoscope symposium, November 2007
Plan

- Presentation and demo of Aplusix
- Experiments
- A commercial product
- Specific and future developments
The training mode

- Students make their own calculations using the two-dimensions editor
- APLUSIX verifies the students’ calculations
- APLUSIX verifies the end of the exercise
Demos in the training mode

• An equation of the map
  – Indication of the solution
  – Scores
• A look at The Map
• Exercises from textbooks
• Exercises and problems from files
• Commands
  – Cubic equation
  – System 3x3
• Suppression of a common denominator
• Detached steps
• Several branches
The domain of APLUSIX

- Numbers
  - integers, decimals, fractions, square roots
- Expansion
  - several variables
- Factorizations
  - one variable, degree ≤ 4
  - two variables, degree ≤ 2
- Equations and inequations
  - one unknown, degree ≤ 4
- Systems of linear equations
  - up to 10 equations and 10 unknowns
- Word problems
- In January 2008
  - Factorizations of integers with prime numbers
  - Simplification of rational fractions
Four interaction modes

• Training: with feedback
• Test: without feedback
• Self-correction: delayed feedback after a test
• Observation: final form or action by action
Tools for the teacher

• Parameters
• Annotations
• Statistics
• The exercise editor
• The administration program
Parameters

- Allowing the teacher to choose the way many functionalities work
Annotations

• The teacher annotates the student’s work

• Later, the student reads the annotation
Statistics

Yellow: number of erroneous steps

Green: number of well solved exercises

Red: number of attempted exercises
An editor of exercises and problems

1. In the figure below
   - ABCD is a square of side $x$ cm.
   - ECF is a right triangle in C.
   - Point E belongs to [BC].
   Let FC = 4 cm.

Express the area of the square ABCD as a function of $x$. 

Answer: $x^2$
An administration program

• Allowing
  – To create classes
  – To manage teachers’ and students’ accounts
  – To clear old data
Platform

- Aplusix is developed in Delphi
- Aplusix runs on Windows, from 98 to Vista
Experiments
A short large scaled experiment in Brazil

- 1120 students, one student per computer
- Grade 9
- Linear equations
- 2 hours of use (2 sessions)
- Pre-test and post-test with Aplusix
- Improvement of 31% of the number of well solved exercises
Collaborative learning in India

- 78 students, 20 groups of 3 or 4
- Grade 8
- Numerical calculations and expansions
- 4 hours of use (4 sessions)
- A pre-post-test on paper corrected by teachers with exercises of the official curriculum
- 15% students of the weak group (score 0-2) moved to the medium group (score 3-7)
- 15% students of the medium group (score 3-7) moved to the highest group (score 8-10)
Remedial intervention in symbolic manipulation in Italy

- Grade 9, expanding and factorizing
- A pre-test in paper and pencil to reveal specific difficulties
- A set of scenarios with Aplusix
- Two final tests
- Effectiveness of the intervention
  - Dramatic decrease of the numbers of errors
  - Self confidence
  - Self control
  - Students’ consciousness of their difficulties
- A typical student’s opinion

*With Aplusix, everything seems easier than in paper and pencil. When I see the red lines, I understand that I have made an error, I like it very much...When my teacher corrects my test I don't look at the errors, the most important thing I pay attention is the good or bad mark got.*
Use of Aplusix all along 8 months in France

• Aplusix has been used all along the year at Grade 10
  – In reinforcement for all students during 6 sessions
  – In individualized help for some students

• Ratio of students having a score higher 10 over 20
  – 25% in September
  – 68% in March

• The teachers also noticed a significant improvement of the results with regard to the previous years (without Aplusix)
A commercial product
A commercial product

• Publishers
  – France: Les Editions Archimède (July 2005)
  – UK: Chartwell-Yorke (January 2007)
  – Italy: Media Direct (January 2007)
  – Benelux: Rhombus (December 2007)

• A start-up company in 2008
Specific and future developments
Tree representations

In the framework of the ReMath European project

Students manipulate trees to better understand algebraic expressions

- Build a tree representation of a given expression
- Write a usual expression corresponding to a tree
- Expand and collapse trees
- Work on trees instead of usual expressions

A prototype which is currently experimented
The companion

A companion able to:
- Give suggestions
- Solve exercises (step by step)
- Give explanations

→ Ongoing development

For a new version in 2008
Graphical representations of several algebraic expressions chosen by the student.

When two expressions are equivalent, the graphical representations are identical.

Aplusix on the web

• A windows application using Web services is under development
  – The curriculum will be displayed on a web server
    It is country and level dependant
  – The student will browse and launch exercises
• Later, a Java version running in a browser will be developed
The END

Thank you