

Interactive Learning Environnements

INRP

TECNE

Informatique et enseignement

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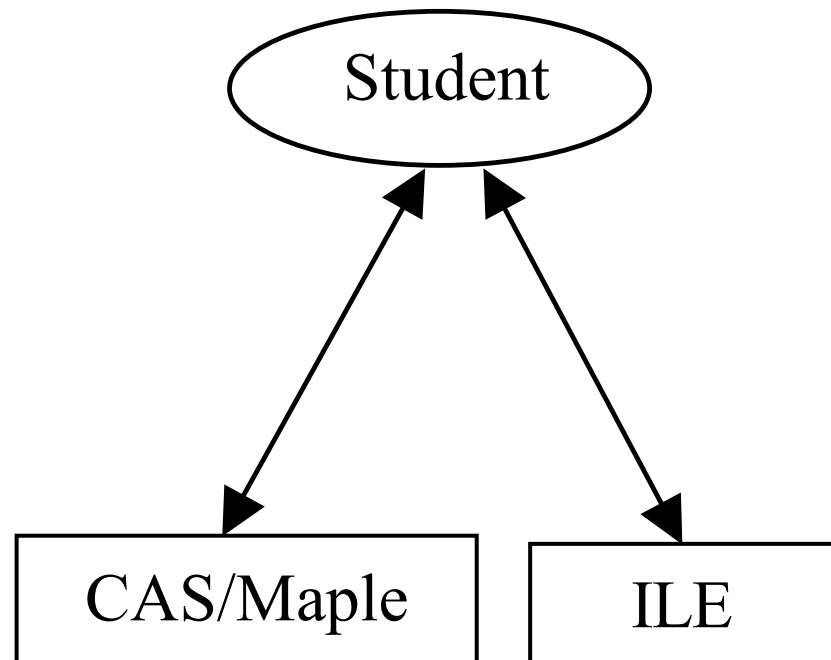
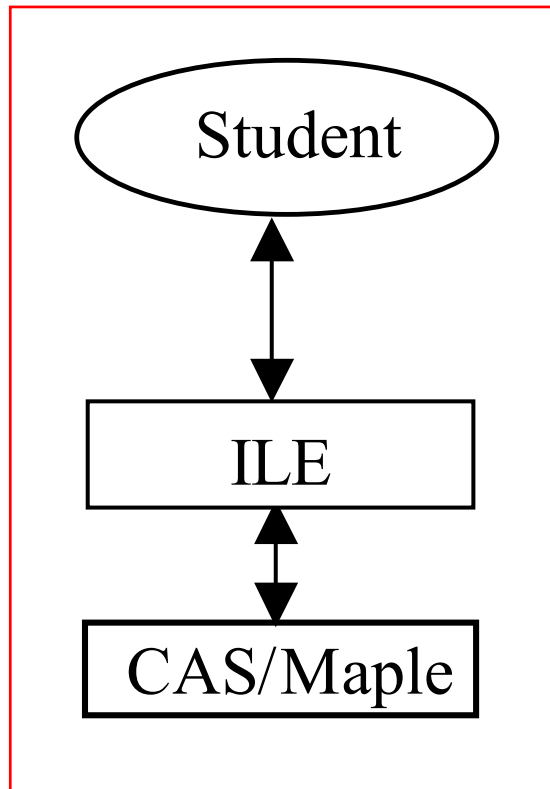
Design

- Domain : science education
- Design
 - Starts from questions in teaching or learning
 - Involves teachers and researchers in science education
- Modeling
 - Domain and knowledge models,
from state of the art in computer science
 - Interaction models
from analysis of students interactions with software
- Examples : maths, chemistry

ILE in mathematics : LIMITES

- Question :
 - Interest of Computer Algebra Systems in maths education
 - Maple, Mathematica, Derive,
 - Known difficulties
 - Objects in Computer Algebra Systems are not mathematical objects
- Domain
 - Analysis (high school level) : Limits
- Actions :
 - Make conjectures (graphical, numerical)
 - Transform expressions
 - Develop proofs

Architecture



Transforming expressions

- Useful transformations do not match existing MAPLE functions
- Examples :
 - Factor
 - Expand

$$\frac{(2x+3)(5x-2)}{x^2-7} \quad \text{on développe}$$
$$= \frac{10x^2 + 11x - 6}{x^2 - 7} \quad \text{on met } x^2 \text{ en facteur}$$
$$= \frac{10x^2 + 11x - 6}{x^2 \left(1 - \frac{7}{x^2}\right)}$$

Copier	Ctrl+C
Annuler	Ctrl+Z
Parenthéser/Déparenthéser	
Réordonner	
Réduire	
Développer	
Réduire la fraction	
Expression conjuguée	
Mettre en facteur...	
Factoriser...	
Remplacer par...	
Simplifier par...	
Sortir du radical	

Proof at different knowledge levels

Level1 : all the steps

Level 3 : implicit limits
more general theorems

$$\lim_{x \rightarrow +\infty} 1 = 1 \quad \text{Limite de référence}$$

$$\lim_{x \rightarrow +\infty} 3 = 3 \quad \text{Limite de référence}$$

$$\lim_{x \rightarrow +\infty} x^2 = +\infty \quad \text{Limite de référence}$$

$$\lim_{x \rightarrow +\infty} \frac{3}{x^2} = 0 \quad \text{Quotient}$$

$1 + \frac{3}{x^2}$	<ul style="list-style-type: none"> Limite de référence Limite d'une fonction continue Somme Produit Quotient Racine
$2 - \frac{7}{x^2}$	<ul style="list-style-type: none"> Afficher les limites de référence

$$\lim_{x \rightarrow +\infty} \frac{3}{x^2} = 0 \quad \text{Quotient sans indétermination}$$

$1 + \frac{3}{x^2}$	<ul style="list-style-type: none"> Limite de référence Limite d'une fonction continue Somme sans indétermination Produit sans indétermination Quotient sans indétermination Racine
$2 - \frac{7}{x^2}$	<ul style="list-style-type: none"> Afficher les limites de référence

Tous les termes ont une limite finie
Limite +inf pour certains, finie pour les autres
Limite -inf pour certains, finie pour les autres

ILE in chemistry : SCHNAPS

- Question
 - learning difficulties about quantities in a chemical reaction, specially relations between amount of substance
- Actions
 - Define the situation : reaction and initial conditions
 - Develop pieces of a solution in a worksheet
 - Get adapted help :
advice, style, concepts, algebra, meta help, ...

Develop a solution

The screenshot shows the 'Schnapps v 3.01' software window. At the top, the title bar reads 'Schnapps v 3.01' and the menu bar includes 'File', 'Edit', 'Help', 'Problem', and 'Settings'. Below the menu bar, the 'Chemical equation' section displays the balanced equation: $4 \text{NH}_3 + 5 \text{O}_2 \rightarrow 4 \text{NO} + 6 \text{H}_2\text{O}$. The main area is titled 'Searching and writing sheet' and contains a list of buttons on the left: 'Data', 'Question', 'Definition', 'Goal', 'Relation', 'Calculate', 'Stoichiometry', 'Comment', 'Calculate again', 'Help', and 'Solution'. The right side of the window is a text area with a scroll bar, containing the following text: 'The initial volume of ammonia is 13 l', 'The initial volume of dioxygen is 15 l', 'Let n_{NH_3} the amount of substance of n_{NH_3} before reaction', ' $n_{\text{NH}_3} = 13 \text{ l} / 22.4 \text{ l} \cdot \text{mol}^{-1} \Rightarrow n_{\text{NH}_3} = 0.5804 \text{ mol}$ ', ' $15 / 22.4 = 0.6696$ ', 'Goal : looking for the excess reactant', 'Let v_{NO} the volume de NO after reaction', and ' $n_{\text{O}_2} = 5 * v_{\text{NO}} / 4 * 24$ '. Below the last equation, there is a blue asterisk symbol '=== * ==='.

Conceptual help

Gas





A **gas** is a state of matter characterised by :

- A **gas** has a **definite mass** but **no definite volume** and no definite shape ; it expands to fill the volume of its containing vessel.
- A **gas** consists of **independent particles** spread in the whole volume, in random motion.

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The **molar volumes** of all gases at the same pressure and temperature are equal,
or,
Equal volumes of all gases contain equal numbers of moles of substance at the same pressure and temperature.

number of mole is : 0.6 mol

gases (t=25°C)			
H_2 2 g x mol ⁻¹	CH_4 16 g x mol ⁻¹	Cl_2 71 g x mol ⁻¹	NO_2 46 g x mol ⁻¹
			
m = 1.2 g	m = 9.6 g	m = 42.0 g	m = 27.0 g

volume of the balloons is : 14.0 L

This is called *Avogadro's Hypothesis* principle.

Quit

Help and assistance

- Powerful software available for education
 - Generic or specific
- Easy to use interfaces
- Requires some expertise form the users
- How users / learners can get expertise ?
 - help, guidance, assistance

Information searching on the web

- Available tools : search engines, thematic indexes, ...
- Web as a large knowledge base useful for students
- Research in cognitive science and information science:
 - novices # experts
- Study of students navigation and searches
 - Need for assistance
- ARI (Assistant de Recherche sur Internet) :
 - Reduce cognitive overload :
structured history of navigation
 - Provide a framework for note taking

ARI : review of browsing and notes taking

The screenshot displays the ARI (Automatic Reporting Interface) software. The main window is titled "Prise de notes - G1_emilie". It features a menu bar with "Quitter", "Historique seul", "Historique et rapport", "Rapport seul", and "Aide". Below the menu bar, there are tabs for "Liste" and "Sessions".

The left pane shows a hierarchical file tree under "Google rech Simple equ = destruction de la couche d'ozone soleil 1 - c". The tree includes folders like "www.ec.gc.ca" and "www.cybersciences.com", and files such as "/ozone/protect/sect1_f.html - copie" and "/Chronique/2000/mars-juillet/000616_ozone.htm - copie".

The right pane shows a document viewer with the text "Document actif : Couche d'ozone". The content includes the year "1980." and a paragraph about the Montreal Protocol: "Le Protocole de Montréal a réussi à stabiliser le taux de CFC dans la stratosphère, ce qui est bien, mais la météo joue aussi. Les hivers très froids multiplient l'effet des CFC sur l'ozone. Des cristaux de glace se forment dans l'air glacial au-dessus des calottes polaires. Ces cristaux forment une surface sur laquelle se produit facilement la réaction chimique qui transforme les CFC en substances". To the right of the text is a satellite image of the Earth showing the ozone layer, with a caption: "La situation le 9 septembre 201... contour plus foncé des continer".

The bottom pane shows a notes editor with the title "Couche d'ozone". The content includes the heading "Qu'est-ce que la couche d'ozone" and a paragraph: "La couche d'ozone, qui est le seul écran solaire naturel de notre planète, se trouve dans la haute atmosphère terrestre. Elle agit comme un filtre invisible qui protège toutes les formes de vie contre les dangers de la surexposition aux rayons ultraviolets (UV) du soleil." Below the text is a graphic of a sun with rays.

The bottom-left pane shows a file explorer with folders like "VISITE", "Chantiers", and "Couche d'ozone". The "Couche d'ozone" folder contains files like "Qu'est-ce que la couche d'ozone", "destruction de la couche d'ozone", "cycle de l'ozone", "effets sur la santé", and "Conclusion". There are also buttons for "Archiver" and "Supprimer".