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Implementation of a Dynamic and Multipolar Approach in the Teaching of Chemistry in the 5th Grade of the French Education System

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Abstract

In order to improve quality of learning in chemistry in the 5th grade at the Lycée Français de Tamatave, a dynamic and multipolar approach was used in designing a curriculum. As results, the curriculum allowed students develop both disciplinary skills prescribed in the program, and transversal skills. Moreover, a better appropriation of the notional contents corresponding to disciplinary skills was noticed. However, the proposed approach should be applied in all levels of schooling, from secondary school to university, in order to prepare students for the workplace in their future.

Keywords

Learning Process, Dynamic and Multipolar Approach, Proficiency Level, Quality of Learning

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1. Introduction

The application of the skill-based approach in teaching chemistry in the 5th grade of the Lycée Français de Tamatave during the 2016-2017 school year allowed identifying the gaps in student learning [1]. Indeed, being an approach based essentially on the realization of activities, this pedagogical approach does not require the acquisition and the mastery of disciplinary knowledge, which is nevertheless the subject of the learning of a subject. Rather, it focuses on students' ability to mobilize the resources available to them in order to solve contextualized problems.

In order to improve the quality of chemistry learning in the 5th grade of the French education system, a dynamic and multipolar approach focused on pedagogical development and pedagogical innovation may be applied [2]. The mapping of the processes resulting from the application of the quality approach in learning allowed elaborating a teaching curriculum of the chemistry, based on the disciplinary skills and the contents defined in the program of physics and chemistry for the 5th grade. This curriculum defines the activities to be carried out according to an annual progression, the means used at each step, as well as the teaching methods implemented.

During the 2017-2018 school year, the new curriculum was implemented in a class of 5th grade at Lycée Français de Tamatave. In order to assess the quality of learning, the level of mastery of each disciplinary skill was taken into account for each student. To get an idea of the impact of the approach on the contribution of the learning of chemistry in the lifelong learning, the progression in the development of transversal skills was also considered.

The implementation of the dynamic and multipolar approach in the teaching of chemistry in the 5th grade at the Lycée Français de Tamatave seeks to improve the quality of student learning, by filling the gaps of the use of the skill-based approach. In the light of evaluation standards defined in the training program, the expected effects are a good mastery of

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the disciplinary contents, and a differentiation in the acquisition of disciplinary and transversal skills.

2. Implementation of the Curriculum

As part of the teaching of chemistry in a class of 5th grade of the Lycée Français de Tamatave, we implemented a curriculum based on the skills of the program corresponding to chemistry, which are the outputs of learning. Each activity aims to teach students these skills.

2.1. Inputs

In the category of inputs used, the student manual is an interesting resource for application exercises, some practical work and some documentary studies. The learning management system was Pronote, a digital workspace developed by Index Education [3] and used by the school, where each teacher and student has an access account. On Pronote, teachers and students can access, share, publish, and leverage online content and integrated digital resources, and communicate using a messaging service, facilitating collaborative learning.

Pronote allows the teacher to communicate with students, set up an online homework diary and assignments for upcoming sessions, publish content, post exercises, edit questionnaires and polls, and manage the assessment of skills. The teacher can create interactive exercises, customizable and adaptable to the course, to choose the modalities of execution of the questionnaires according to his needs (single or multiple choices, seizures, spelling, associations, texts with holes), and to associate a questionnaire course content or exercise. As a result, Pronote allows teacher managing student responses, performing statistical reports on skill acquisition, and making personalized accompaniments.

With Pronote, students can learn about the elements of the program which will be worked on during a session, make a homework assignment or report online after the classroom session, consult the skills report and evaluated knowledge, download attachments to an activity, internet links and content posted by the teacher, to make revisions using questionnaires. An integrated messaging service allows questions to be asked to the teacher in case of difficulty, to interact with classmates outside class hours, or to open discussion groups on a subject that may be interesting for the all students.

The Pronote software has a web version installed on the school's website allowing students to work at their own pace according to their needs, and a Pronote Mobile application available on the App Store, Google Play and Microsoft Store, so that users can access anytime and anywhere. The teacher can have his pupils reviewed with their preferred device (computer, tablet or smartphone).

As part of the use of the different versions of the Pronote platform, for the download and viewing of video clips, and the education of students for educational uses of the digital devices, we gave access to computers in theaters during sessions and practical work, with the possibility of connecting to the internet. In the same way, we allowed the use of students' smartphones and personal tablets to view digital resources, take pictures and videos for reports and presentations, take notes or record the explanation of the teacher. The sharing of documents between students can then be done during the session, digital productions of different forms (video capsules, soundtracks, text files) were accepted.

2.2. Implemented Curriculum

In order to enable the student to progress in the acquisition of skills and to master the disciplinary content, each activity is associated with notions, resources and varied learning methods.

Table 1. Implemented curriculum.

Session	Activities	Contents	Mobilized resources	Learning modalities
1	Practical work	Chemical elements in the Universe 1. Conservation of the copper element	Experiment protocol Review of the experience	Group work Magisterial presentation
2	Tutorials	1. The model of the atom 2. Nucleus (protons and neutrons), electrons 3. Number of charges and atomic number Z 4. Number of nucleons A 5. Elementary electric charge, charges of the constituents of the atom 6. Electro-neutrality of the atom	Video capsule Summary of essential concepts	Lesson provided before sessionPositioning questionnaire Group work
3	Tutorials	1. Mass of the constituents of the atom, approximate mass of an atom and its nucleus 2. Dimension: order of magnitude of the ratio of the respective dimensions of the atom and its nucleus		Literature search Group work
4	Practical work	1. Ion identification tests	Experiment protocol	Literature search Magisterial presentation Group work

Session	Activities	Contents	Mobilized resources	Learning modalities
5	Tutorials	1. Chemical elements. 2. Isotopes, monoatomic ions. 3. Characterization of the element by its atomic number and its symbol.	Video capsule Summary of essential concepts	Lesson provided before session Magisterial presentation Group work
6	Practical work	1. Conservation of the iron element	Experiment protocol Review of the experience	Group work Individual work
7	Tutorials	1. Distribution of electrons in different layers, called K, L, M. 2. Distribution of electrons for atomic number elements between 1 and 18.	Video capsule Summary of essential concepts	Lesson provided before session Positioning questionnaire Group work
8	Tutorials	1. The rules of "duet" and octet. 2. Application to the usual monoatomic ions	Video capsule Summary of essential concepts	Lesson provided before session Group work
9	Presentation by students	1. Mendeleev's approach to establish his classification. 2. Current classification criteria: atomic number and number of electrons of the outer layer	Presentation plan	Literature search
10	Tutorials	1. Using the periodic table of elements to recover the charge of the ions	Table of periodic classification of chemical elements	Magisterial presentation Group work
11	Remediation	Chemical elements in the Universe	Mind map	Individual work Peer tutoring Personalized support
	Deepening exercises	Problem solving on the chemical composition of planets in the solar system	Method-sheet Data processing software	Group work
12	Examination	Chemical elements in the Universe	Homework preparing examination	Individual work Correction collective
13	Practical work	The mole 1. Preparation of a solution by dissolution	Summary of essential concepts Experiment protocol	Positioning questionnaire Magisterial presentation Group work
14	Tutorials	1. Solution: solvent, solute, dissolution of a molecular or ionic species. 2. Mass and molar concentrations of a species in unsaturated solution.	Video capsule Summary of essential concepts	Lesson provided before session Positioning questionnaire Group work
15	Remediation	The mole	Summary of essential concepts	Individual work Peer tutoring Personalized support
	Deepening exercises	Problem solving on drug preparation	Method-sheet	Group work
16	Practical work	1. Dilution of a solution	Experiment protocol	Positioning questionnaire Magisterial presentation Group work
17	Presentation by students	Drugs 1. Active ingredient, excipient, formulation 2. Natural and synthetic chemical species 3. Characteristic groups	Presentation plan	Literature search
	Tutorials	1. Formulation of drugs	Summary of essential concepts	Positioning questionnaire Group work
18	Formative evaluation	The mole Drugs	Mind map	Individual work Collective correction
19	Remediation	The mole Drugs	Summary of essential concepts	Individual work Peer tutoring Personalized support
	Deepening exercises	Problem solving on drugs administration	Method-sheet	Group work
20	Examination	The mole Drugs	Homework preparing examination	Individual work Collective correction
21	Presentation by students	Identification of a chemical species 1. Physical characteristics of a chemical species	Presentation plan	Literature search Group work
	Practical work	1. Interaction with the environment	Experiment protocol	Positioning questionnaire Group work
22	Presentation by students	Extraction and synthesis of chemical species 1. Techniques for extraction, separation and synthesis of chemical species	Presentation plan	Literature search Group work
23	Practical work	1. Thin-layer chromatography	Video capsule Summary of essential concepts Experiment protocol	Lesson provided before session Positioning questionnaire Group work
24	Practical work	1. Hydrodistillation	Video capsule Summary of essential concepts Experiment protocol	Lesson provided before session Positioning questionnaire Group work

Session	Activities	Contents	Mobilized resources	Learning modalities
25	Practical work	1. Synthesis of a drug	Video capsule Summary of essential concepts Experiment protocol	Lesson provided before session Positioning questionnaire Group work
26	Examination	Analysis of experiences	Mind map	Individual work
27	Practical work	1. Reaction between bicarbonate and vinegar	Video capsule Summary of essential concepts Experiment protocol	Lesson provided before session Positioning questionnaire Group work
28	Tutorials	1. Chemical system 2. Chemical reaction 3. Symbolic writing of the equation of a chemical reaction	Video capsule Summary of essential concepts Method-sheet	Lesson provided before session Magisterial presentation Group work
29	Practical work	Chemical reaction 1. Thermal effect of a chemical transformation	Video capsule Summary of essential concepts Experiment protocol	Lesson provided before session Positioning questionnaire Group work
30	Remediation	1. Symbolic writing of the equation of a chemical reaction		Individual work Peer tutoring Personalized support
	Deepening exercises	Problem solving on doping	Method-sheet	Group work
31	Examination	Chemical reaction	Homework preparing examination	Individual work

2.3. Evaluation Method

The assessment of a skill was done considering the progress of each student on several sessions. An evaluation grid is given to each student at the beginning of the year, checked at the beginning of the session so that the teacher directs each student to the work he has to do, and completed at the end of the session by the teacher in order to indicate to the student the points which he must revisit or deepen. The level of proficiency of the student on each disciplinary skill is evaluated on 4 levels:

a. the pupil masters the skill by performing the task associated with it satisfactorily according to the specified criteria, independently, or with the help of his peers or with one or two interventions by the teacher, concerning difficulties identified and explained by the student and to which he provides an answer almost of himself;

b. the student completes the requested task satisfactorily according to the specified criteria, with the help of his peers, or one or two interventions by the teacher concerning difficulties or errors not identified by the student, but resolved by the student in an autonomous way, after thinking about it;

c. the student is stuck in his process and uses the input of his peers or the teacher;

d. the student is unable to perform the requested task despite the help of his peers and the teacher, thus demonstrating an insufficient mastery of the required skill.

3. Results

The curriculum was implemented in a class of 5th grade of the Lycée Français de Tamatave, an educational institution applying the French education system, which is composed of 31 students.

3.1. Evaluation of Disciplinary Skills

The results reported in the table for each skill are those obtained eat the end of all the activities in which it was developed.

Table 2. Results at Lycée Français de Tamatave.

Skills	Proficiency level			
	A	B	C	D
Practice an experimental procedure to check the conservation of the elements during a chemical reaction	61,29%	25,81%	12,90%	00,00%
Know the constitution of an atom and its nucleus	54,84%	38,71%	6,45%	00,00%
Know and use the symbol $^{4}_{2}X$	54,84%	38,71%	6,45%	00,00%
Know that the atom is electrically neutral	22,58%	32,26%	41,93%	3,23%
Know the symbol of some elements	100%	00,00%	00,00%	00,00%
Know that the atomic number characterizes the element	74,19%	25,81%	00,00%	00,00%
Know that the mass of the atom is almost equal to that of its nucleus	12,91%	25,81%	48,37%	12,91%
Establish the electronic structure of an atom	100%	00,00%	00,00%	00,00%
Enumerate the electrons of the outer layer	100%	00,00%	00,00%	00,00%
Know and apply the "duet" and byte rules to account for typical monatomic ion charges	19,35%	32,26%	22,58%	25,81%
Use the periodic table to recover the charge of monoatomic ions	12,91%	29,03%	35,48%	22,58%

Skills	Proficiency level			
	A	B	C	D
Implement a protocol to identify ions	54,84%	25,81%	19,35%	00,00%
Distinguish the solute from the solvent	48,37%	25,81%	16,13%	9,69%
Know that the concentration of a dissolved solution can be expressed in $g.L^{-1}$ or in $mol.L^{-1}$	41,94%	48,37%	9,69%	0,00%
Determine the mass concentration of the solution to be prepared	25,80%	35,49%	25,80%	12,91%
Calculate a molar mass from atomic molar masses	100%	00,00%	00,00%	00,00%
Calculate the mass of the required solute	83,88%	16,12%	00,00%	00,00%
Determine the mass of a sample from its density or density	100%	00,00%	00,00%	00,00%
Determine a quantity of matter, knowing the mass of a solid	83,88%	16,12%	00,00%	00,00%
Elaborate a dissolution protocol	12,91%	16,12%	41,94%	29,03%
Collect a quantity of material from a given chemical species	25,80%	35,49%	38,71%	00,00%
Implement a dissolution protocol	48,37%	38,71%	12,92%	00,00%
Know and exploit the expression of the mass and molar concentrations of a dissolved molecular species	29,03%	41,94%	15,84%	12,92%
Calculate a quantity of material	32,25%	38,71%	16,12%	12,92%
Elaborate a dilution protocol	22,58%	16,12%	45,18%	16,12%
Prepare a solution by dilution	38,71%	45,17%	16,12%	00,00%
Determine the concentration of the solution by the comparison method	6,45%	22,58%	41,94%	29,03%
Know that a formula can correspond to several semi-developed formulas	6,45%	16,13%	38,71%	38,71%
Identify the presence of characteristic groups in a developed formula	9,69%	25,80%	41,94%	22,57%
Determine the different forms of an active ingredient	12,91%	29,03%	41,94%	16,12%
Differentiate the active ingredient from the excipients	19,35%	32,26%	22,58%	25,81%
Characterize a drug	22,58%	38,71%	38,71%	00,00%
Recognize a brand-name drug	19,35%	32,26%	22,58%	25,81%
Recognize a generic drug	19,35%	32,26%	22,58%	25,81%
Differentiate a generic drug from a brand-name drug	9,69%	16,12%	35,48%	38,71%
Prescribe a drug	6,45%	22,58%	29,03%	41,94%
Develop a protocol to check the acidity of a solution	16,12%	32,26%	38,71%	12,91%
Measure the pH of a solution	48,37%	38,71%	12,92%	00,00%
Develop a protocol to simulate the action of a drug on the human body	9,69%	16,12%	35,48%	38,71%
Implement a protocol to simulate the action of a drug on the human body	83,88%	16,12%	00,00%	00,00%
Conclude on the parameters influencing the choice of drugs	61,29%	25,81%	12,90%	00,00%
Develop a protocol for thin layer chromatography	38,71%	35,48%	16,12%	9,79%
Perform thin layer chromatography	100%	00,00%	00,00%	00,00%
Interpret thin layer chromatography	48,37%	32,26%	6,45%	12,91%
Analyze the formulation of a drug	22,58%	54,84%	16,12%	6,45%
Explain the principle of hydrodistillation	38,71%	48,37%	9,79%	3,13%
Explain the principle of solvent extraction	38,71%	48,37%	9,79%	3,13%
Use a heater in safe conditions	83,88%	16,12%	00,00%	00,00%
Use a separating funnel	83,88%	16,12%	00,00%	00,00%
Implement a hydrodistillation protocol	61,29%	38,71%	00,00%	00,00%
Implement a solvent extraction protocol	61,29%	38,71%	00,00%	00,00%
Describe a chemical system and its evolution	12,91%	29,03%	54,83%	3,13%
Write the equation of the chemical reaction with the correct stoichiometric numbers	16,12%	54,84%	22,58%	6,45%
Propose a protocol to identify a molecule	22,58%	35,48%	32,15%	9,79%
Implement an experimental protocol to perform the synthesis of a molecule	90,21%	9,79%	00,00%	00,00%
Implement an experimental protocol to highlight the thermal effect of a chemical transformation	87,09%	12,91%	00,00%	00,00%
Calculate the energy released during a chemical transformation	29,03%	25,81%	29,03%	16,13%

It appears that the experimental skills are easily assimilated by the students, when they are mobilized to doing practical work. Achieving low cognitive engagement activities such as application exercises and documentary researches enables students to acquire skills that match the levels of knowledge, understanding, and application in Bloom's taxonomy [4]. For analytical and synthesis skills such as protocol development and interpretation of experimental results, only the most successful students demonstrate satisfactory mastery on a regular basis. A satisfactory mastery for all students was achieved for the knowledge of the symbols of the elements, the electronic structure of the atoms, the calculation of the molecular molar mass and the application of the density formula.

3.2. Development of Transversal Skills

At the beginning of the school year, students discovered new learning modalities such as investigative approach and

collaborative learning, and learned to use digital tools for learning purpose. The teacher assisted them in the implementation of new pedagogical practices. As activities were diversified, students became accustomed to collaborative work and self-employment, and to viewing video clips. The formation of the groups was done by the teacher starting from the third activity, when the teacher distinguished the performing pupils, the average students and the pupils with difficulty, and the constitution of the groups are dynamic according to the activities.

Peer learning fostered listening, empathy, and self-help, and successful students who are responsible for providing help to peers developed expression skills which are the foundation of leadership. Through the differentiation in the formation of the groups, the high-performance students developed their critical thinking and their creativity during the exercises of deepening which were proposed to them, and the pupils in difficulty took the confidence during remediation exercises which were done individually.

The use of digital tools throughout the school year pushed students to master these for educational purposes. In fact, students discovered new features such as the filing of online work, quizzes, video clips. Presentations and proceedings of practical work allowed students to be creative in the use of ICTs; we raised the production of audio tapes, video capsules, and animations. The exchanges between the students and the research on the internet also allowed them to deepen the topics discussed in class and share these with their classmates, thus engaging the most motivated students in a process of research and deepening.

The diversity of activities led students to research, retrieve and organize useful information from the plethora of information which was made available to them. These activities led students to mobilize knowledge they acquired in the lower classes and in other subjects, and to consider them systemically to solve contextualized problems.

4. Discussions

Through the contextualization of activities, students are motivated to perform the tasks. Indeed, the anchoring of learning in reference practices such as everyday situations and professional environments gives meaning to the disciplinary concepts, and promotes student engagement. The pupils realized that the knowledge they acquired will be useful to them during their schooling and for future integration into the world of work. Beyond the resolution of the problems, they developed their interest and their curiosity towards chemistry. On the quality of learning, students' motivation is reflected in the good level of mastery of experimental skills and comprehension and application skills.

As part of the differentiation of learning, teacher coaching and peer tutoring led students to overcome their failures. Indeed, the exercises proposed to each student allowed him to return to the notions on which he is in difficulty, and developed the feeling of self-confidence and success. The use of Pronote as a communication tool allowed the teacher to be available to the students and gave them the opportunity to exchange, encouraging them to continue the work outside the classroom. The possibility of being able to follow his progression in the mastery of the skills allowed the student to focus on his weak points when working alone, notably during the revision for a summative evaluation.

The adoption of the flipped classroom promoted the development of low cognitive skills. The outsourcing of the course and the use of memory cards and mental maps allowed the students to focus on the operationalization of disciplinary knowledge in the implementation of the application exercises. The provision of experimental protocols during the practical sessions gave all students the opportunity to perform the tasks correctly, even for those who failed to develop good proposals. At the end of the session, students concentrated on the teacher's presentation and took personal notes, knowing that they will have a summary of the essential concepts to remember at the end of the course, on the Pronote platform.

At the beginning of the school year, the implementation of new teaching practices created a feeling of mistrust and destabilization among students. The teacher played a key role in supporting and building student confidence, and guiding students on new work methods during the first sessions facilitated all other activities and development of the autonomy of each student. Despite the reluctance of some students during the first activities, the group work allowed the students to pool their skills and share their knowledge, especially by the division of tasks, thus making it clear to the good students that the quality of their learning will be improved, and to give struggling students the confidence that they can succeed with the help of their peers.

The pedagogical uses of digital technology also motivated students. Indeed, the freedom granted to students in the use of digital tools, both in the classroom and outside, led to self-empowerment. When students are guided in the use of their smartphones and tablets for educational purposes, and are put in front of their responsibility in their academic success, they feel in an environment which is familiar to them. The video clips viewed several times indicate that they are appreciated in relation to a lesson given by lecturing, online questionnaires make learning fun, educational and technological communication can overcome psychological barriers such as fear of others' judgment, the inaccessibility of the teacher, the fear of failure.

5. Conclusion

In the French education system, the implementation of a curriculum based on a dynamic and multipolar approach in the teaching of chemistry in the 5th grade is facilitated by the construction of the program around disciplinary skills which facilitate the contextualization of knowledge. It is a question of recalling the disciplinary knowledge mobilized during each activity, specifying the nature of the educational resources used, and breaking down each session into several stages which reflect the various learning methods.

The curriculum was applied in a class of 5th grade at Lycée Français de Tamatave High School, and allowed on the one hand, to improve the level of mastery of the disciplinary skills prescribed in the program, and on the other hand, to promote the acquisition and retention of the essential notional contents corresponding to each competency. In addition, the diversification of activities and the deployment of information and communication technologies led students to develop transversal skills useful for their integration into the new society of the 21st century, including creativity, critical thinking, collaborative work, empathy.

Beyond the improvement of the quality of the learning in chemistry courses in the 5th grade, the implementation of a dynamic and multipolar approach is part of a general approach of preparation of the student to integration into higher education and the workplace. However, continuity of the implementation of this approach from high school to university levels would contribute to the professionalization of the learner from secondary school and the training of the future citizen of the 21st century in the long term, in focusing on essential skills, which would be graded according to the level of the student.

References

[1] Ratsimbatoha, Z. A. (2017). Implementation of the skill-based approach in the teaching of chemistry in the 5th grade of the French education system. *Open Access Library Journal,* 4: e3984. doi: 10.4236/oalib.1103984.

[2] Ratsimbatoha, Z. A. (2018, september). *Design of a new curriculum based on a dynamic and multipolar approach including ICT.* Communication presented at eLearning Africa 2018, Kigali, Rwanda.

[3] Index Education (2017). *Guide pratique PRONOTE.* Marseille (France): Index Education.

[4] Bloom, B. S. & al. (1956). *Taxonomy of educational objectives: the classification of educational goals.* New-York (U.S.A.): McKay.

[5] Blanquer, J.-M. (2010). Programme de physique-chimie en classe de 2nde général et technologique. *Bulletin officiel spécial n° 4 du 29 avril 2010.*

[6] DGESCO (2010). *Former et évaluer par compétences dans le cadre des activités expérimentales.* Paris (France): Ministère de l'Education Nationale.

[7] D'Hainaut, L. (1988). *Des fins aux objectifs de l'éducation. Un cadre conceptuel et une méthode générale pour établir les résultats attendus d'une formation*. Bruxelles (Belgique): Labor.

[8] IGEN (2007). *Les livrets de compétences: nouveaux outils pour l'évaluation des acquis.*(Rapports n°2007-048). Paris (France): Ministère de l'Education Nationale.

[9] IGEN (2011). *Activités expérimentales en physique-chimie: Enjeux de formation.*(Rapport n°2011-111). Paris (France): Ministère de l'Education Nationale.

[10] Jonnaert, P., Lauwaers, A. et Pesenti, M. (1990). *Capacités, compétences, situations et fonctionnement cognitif. Cadre conceptuel de la recherche: « Radioscopie de l'étudiant arrivé au terme du cycle supérieur des études secondaires générales dans l'enseignement francophone »*. Louvain-la-Neuve (Belgique): Université catholique de Louvain.

[11] Le Boterf, G., (1994). *De la compétence. Essai sur un attracteur étrange*. Paris (France): Éditions d'organisation.

[12] Mansour, A. (2012). Approche par compétences. *Repères-IREM*, n°88.

[13] Meirieu, P., (1991). *Apprendre… oui mais comment ?* Paris (France): Editions Sans Frontière.

[14] Perrenoud, P., (1999). *Construire des compétences dès l'école*. Paris (France): Editions Sans Frontières.

[15] Romainville, M., & al. (1998). *Réformes: à ceux qui s'interrogent sur les compétences et leur évaluation*. Forum pédagogie, 21-27.