

Health Education in Primary Schools: The Effects of an Educational Programme on the Representations of HIV/AIDS in Children

DOMINIQUE BERGER (bergerdomi@wanadoo.fr),
DIDIER JOURDAN (djourdan@auvergne.iufm.fr)
and JUDITH BARNOÏN (jbarnoin@auvergne.iufm.fr)
The "School Health Education" Research Team PAEDI 2432, France

ABSTRACT *Health education is a part of the primary school science curriculum in France. Teachers often consider sexuality education and sexually transmitted diseases prevention as a topic they cannot teach without the help of partners. This paper is an account of a research carried out to study the representations of primary school pupils (Key Stage 2, French children, from 9-11) about HIV/AIDS and to analyse the impact of an educational programme on these representations. The programme was based on a socio-constructivist approach to learning. It aimed to modify pupils' representations through regular teacher's activities and interventions of health educators. The results indicate that after the intervention, pupils' scientific knowledge was more precise, and communication about HIV/AIDS between members of the family improved. The representations shifted from a sense of powerlessness and fatality towards a sense of the possibility of acting to forestall infection. Nevertheless, the impact of the intervention was weaker on under-privileged pupils.*

KEY WORDS: *Health education, HIV/AIDS, primary school science education.*

Introduction

In France, health education is included in the primary school science curriculum. A part of this curriculum is called "human body and health education" (MEN, 2002). A quantitative study that focused on teachers' practices showed that health topics are mainly nutrition, hygiene, and dental health (Jourdan, Picc, Aublet-Cuvelier, Berger, Lejeune, Laquet-Riffaud, Geneix, & Glanddier, 2002). In the curriculum, the topic "Reproduction of living beings and sexuality education" concerns children aged 9-11 (Key Stage 2). Teachers often acknowledge that teaching about sexuality education and prevention of sexually transmitted diseases is difficult, because they do not feel comfortable with the subject matter. In a previous study (Jourdan et al., 2002), it had been shown that sexuality and AIDS were tackled by only 8 teachers out of 286 that were involved in the study. However, the curriculum guidelines of the French ministry of education (MEN, 2003) and the World Health Organisation (WHO) texts insist on the necessity for implementing

early sexuality education and HIV/AIDS prevention programs, particularly in primary schools (WHO, 1999, 2004a). In this context, developing exchanges of experiences and partnership between teachers and health educators (school health services and health education NGOs) seems to be quite relevant.

The nature of health education in schools also demands to take ethical questions into account. The aim is not to promote a new secular morality defining the "good" (the health) and the "bad" (the risky behaviours), but to prepare the children for responsible citizenship. Then, teachers in health education should not attempt to impose norms of acceptable behaviours, while taking into account children's peculiarities, expectations, needs, and also their own representations. Children's representations are defined as coherent models used by learners to reason when faced with a problematic situation (Jodelet, 1991; Farr, 1997). The construction of these representations is a rather complex phenomenon and depends on the values and beliefs shared by a social group that give rise to a common outlook manifested during social interactions. As these representations are linked to the individual emotional responses, the cultural and social group (s)he belongs to, they constitute a decisive element in his/her relationships with the world, and are resistant to change. Representations seem very essential (Fischer, 2001), are closely linked to behaviour (Abric, 1997), and cannot be change so easily as knowledge. Any programme attempting to change representations should not only take into consideration the relevant knowledge, but also the social and cultural aspects of the children's daily environment. (Doise & Mugny, 1997). The interest of taking into account pupils' representations in an HIV/AIDS education programme for children under twelve has been already justified (Fassler, Mc Queen, Ducan & Copeland, 1989; Ferron, Feard, Bon, Spyckerelle, & Deschamps, 1989; Thomas, 1991; Sly, Eberstein, Quadano, & Kistner, 1992; Schaalma, Kok, & Peters, 1993; Shonfeld et al., 1993; Kelly, 1995; WHO, 1999, 2004a, 2004b). The present collaborative research attempted to identify and study the initial representations of 9 and 10 year-old pupils relating to aids and to examine the impact of an early educational programme on regular teacher's activities and interventions of health educators. Some of the initial results of the study have been already reported in a French journal for teachers (Berger, Collet, Laquet-Riffaud, & Jourdan, 2003).

Methodology

Most evaluations of health education programs are usually quasi-experimental designs, but to study health education other designs seem more appropriate (Victoria, Habicht, & Bryce 2004). In our context, using the controlled randomized design as a method for assessing the effects of the implementation of a programme would be really difficult. The impact of the intervention on the children's social environment means that attempting to use a control group would be delusive, and that randomisation would be really difficult (Tones & Tilford, 2001). This relates directly to the complex nature of causal chains in public health interventions. Although such an approach has its limits, several authors concluded that they are in favour of a collaborative research design aiming at determining exactly what content and what tools would be most suitable (Darroch & Silverman, 1989; Heymans, 1993). Associating all agents in the design and implementing the programme based on collaborative research design, makes it possible to make the in-

teractions between researcher and agents more visible and transparent (Martinand, 2003; Merini, 2005). These would be otherwise masked and confounding factors.

The data for the present study concern the two sides of the collaborative research. On one hand, an account of the general course of the study is provided and, on the other hand, the results from two questionnaires (pre- and post-questionnaire) that were used to collect information on pupils' representations are compared and analyzed.

Programme

The model on which this study was based relates to the "allosteric learning model" described by Giordan (1995). This socio-constructivist model assumes that learners build knowledge from their own lives, and learn through their mental representations that depend on their social and biological experiences, and their dispositions. Learning is a highly active mental process that operates in an integrative mode in the conflict between what a learner has in his/her mind and what (s)he can identify and understand from his/her environment. When a learner develops a new model, all his/her mental models must be reorganized based on an interaction between the pre-existing representations and new information from environmental sources (Giordan, 2000). Health education requires the teacher to take the pupils' representations into account and to help them construct new and more relevant ones. Moreover, the child's environment must be taken into account in the programme as children's representations are not only based on what they learned at school, but also on all the other aspects of a child's life (Downie, Tannahill, & Tannahill, 1996).

The research programme was developed by the Auvergne I.U.F.M. (Teachers' Training Institute), the I.N.R.P. (National Institute for Pedagogical Research) and the School of Medicine at the University of St Etienne, in partnership with the local School Health Services. The research design was regularly approved and evaluated by a pilot committee, which defined its ethical framework on the basis of the texts published by the French Society of Public Health. This was composed of parents' associations, Regional Health Authorities (DDASS), the School of Medicine, the Training Institute, primary teachers, the heads of the schools concerned, and the technical advisers of school health services. The implementation of the project in each school involved its approval by the school council, a meeting with the parents, the training of those involved, and the action in the classroom.

Figure 1 shows the design of the collaborative research. It was founded on six principles:

1. A complementarity of regular teacher's activities and interventions of health educators.
2. A thorough preparation for the context of the project, which associated the families, teachers, and school health services in a comprehensive approach. The partners were closely involved in the design of the study (questionnaire, interventions in the classrooms, relationship with the population).
3. The inclusion of all the classes of the same level in a school.
4. The choice of working with groups of children (no more than 15).
5. The decision to put children in groups according to gender (separating girls from boys).

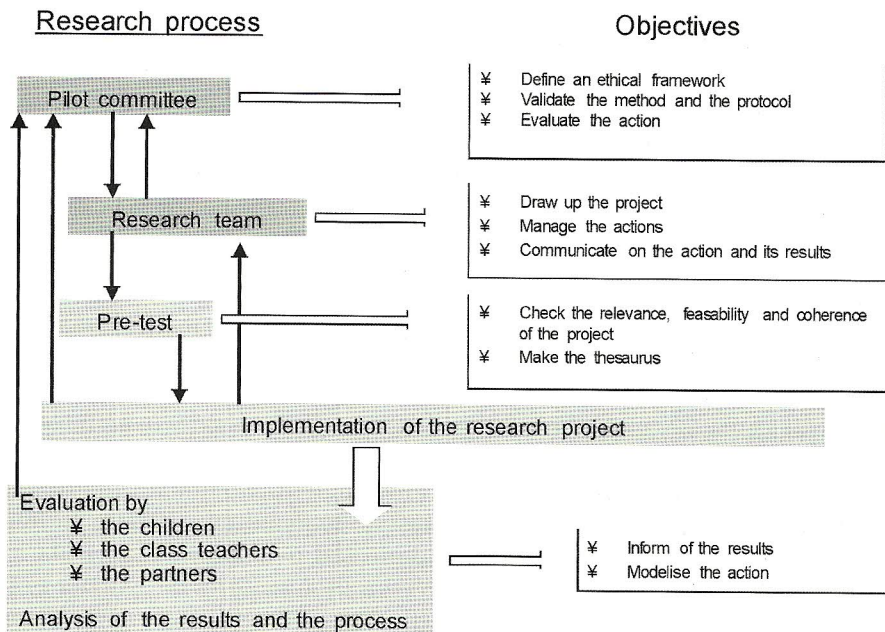


Figure 1. Presentation of the Research Process.

6. A participatory design with games and tools that were designed targeting a high rate of participation.

The programme was developed on the basis of previous studies, (see Kirby, 2002 and UNAIDS, 1997). It was first piloted in a school during the school year preceding the study. The team that worked at each site was composed of six people (three per single-sex half group). Two persons from the research team, two representatives of school health services (a nurse and a doctor), and two observers who were to evaluate the teaching project and the way it was implemented.

Evaluation of the process was carried out using the following indicators:

- For the pilot committee, the number of meetings that were held was compared with the scheduling and the number of participants in each category (parents, teachers, doctors, and nurses). There were three interviews with all the members of the pilot committee, one before the project, one between the two sessions, and one after the results of the project had been made available.
- For the school health services, an individual and anonymous questionnaire was used. It dealt with the form of the action, its pedagogical value, and the analysis of the elements benefiting health education in schools. Fourteen school nurses and 14 school doctors were interviewed.
- For the school staff, the same type of individual and anonymous questionnaire was used. All the teachers and heads of schools involved in the programme (28) were interviewed.
- The participation of the parents was measured for every meeting, and

analysed in relation to the age group of the pupils and to the socio-economic status of the schools. Twenty interviews were carried out with parents from 4 categories of schools.

- Each session was evaluated by an outside observer, using a grid including items relating to the way the session went, the interactions between adults and children, the involvement of the children, and the amount of time used by them to speak.

Population

The study was performed in the south east of France (the regions of the Loire and Haute Loire) in 1998-2000. It concerned pupils in "Cours moyen première année" (CM1) and "Cours moyen deuxième année" (CM2), which correspond to Key Stage 2. The sample was composed of 10 schools and 18 classes. Due to the small size of the sample, its characteristics do not correspond to those of the reference population, that is, it was not a representative sample. Nevertheless, schools corresponding to the main types of school in the country were selected (small size / large size; rural / urban; privileged / under-privileged). The research team asked for the teachers' cooperation. All the classes that were asked volunteered and took part in the project. The overall results of the investigation concern 353 children. Among the participating children, 54% were girls and 46% were boys, while 31% and 69% of them came from CM1 and CM2, respectively.

The total sample can be divided into 4 sub-groups depending on the social environment of the school. This classification was established using the criteria of the National Institute of Statistics and Economic Studies (INSEE 2003), that is to say, on the basis of the head of the family's profession. Population A (14%) was severely under-privileged (coming from schools classified as "educational priority zones"). Population B (31%) was relatively under-privileged. Population C (30%) was quite privileged, and D (25%) was highly privileged. This classification brought out variations in the number of children per family. For Population A, there was an average of more than 4 children, for B and C, there was an average of 1.7, and for D, an average 1.5 of children per family. The children from Population A were the only ones to have parents with a significant age difference. The father was on average 10 years older than the mother, whereas, in the other sub-categories, the father was on average no more than 3.5 years older than the mother. However, the average age of the mothers in the four sub-populations was the same (35 years). The children classified in A were generally older than those in the other sub-populations and faced more difficulties at school. Sixteen percent of them repeated a year at least once (16% for the other groups).

Questionnaire

Due to the age of the pupils, it was not possible to use either the same questionnaire for adolescents and adults, or a multiple choice questionnaire to determine, as it was done with adolescents, the way the children represented modes of infection. Indeed, unfamiliar words, coming from adult or adolescent vocabulary about sexuality, inhibited communication in young children (WHO, 1999). However, we designed a new questionnaire based on the ones existing, but the vocabulary was modified based on the results obtained in the pilot study. Thus, in spite of the fact that it made the questions harder to analyse, we used many open questions,

sometimes along with closed questions. Using only closed questions would not have enabled us to grasp the complexity of the representations of AIDS in young children. The validation of the questionnaire (understanding of the questions, coherence between writing questionnaire, and interview) was carried out at the end of the pilot study with a sample of children, who filled in the questionnaire and had an interview thereafter. The questionnaire had 22 questions and tackled 7 aspects:

- Initial representations of the HIV pandemic.
- An assessment of communication about AIDS.
- Knowledge about AIDS
- Modes of infection and protection.
- Determining how close the subject feels the epidemic to be.
- An evaluation of the representations of the possibilities of living with an affected person.
- An evaluation of social and individual representations of solidarity towards affected people. The same questionnaire was used for both the pilot and the main intervention (series 1 and 2).

For the analysis of our pilot investigation, we started by devising a thesaurus. Each answer was put in a lexical category and coded. This made it possible to take subtle differences into account. The total number of words was 255, and the number of items we added to the first version of the thesaurus after our processing was low (< 10%). These precautions were taken in order to standardize the data acquired from the questionnaires and reduce any distortion in interpretation.

Teaching Approach

We initially attempted to measure the impact of an early preventive action on children's representations. The protocol was composed of two interventions in the course of the school year, one at the beginning and one at the end, at least six months later. Between the two interventions, the regular teachers worked on health education with the pupils ("normal" biology course including sexuality education). The two sessions were designed with the same pedagogical structure, which had two requirements, that is, to collect useful evidence from the questionnaires, and to put the children in a position where they were actors in their own learning process. The two sessions were structured as follows: A short presentation of the team and the framework, a question-writing time, a presentation about HIV/AIDS, work in small single-sex groups on the answers to the questions asked without the teachers, a game (a card-game for the first, and role-playing for the second), and, finally, the collective writing of a text for the teacher and the families.

Presenting the Questionnaire

The questionnaire was intended to deal with children's initial representations and it was anonymous. After the pre-test, it appeared to be necessary, in order to attain this goal, to break away from the school environment and the behaviour it induces, especially in relation to writing. So, in the instructions for the procedure, we stressed that neither spelling nor the quality of the writing were important. What we were interested in was what the children thought, and in expressing their ideas in words. There was no question of making things hard for the children by

asking them to write, but we just wanted to get their answers, which we could analyse and then link up with representations. We also explained that we would not give any further explanations about the meaning of the questions, as, we were afraid that in doing so, we could give ideas related to the answers. In order for all the children to be able to fill in the questionnaire as best as they could, we chose a collective approach. Each question was read out aloud and timed. Thus, we were able to include all the questionnaires in the analysis process, even those from children with serious literacy problems.

Information Provided

This presentation was intended to provide precise and complex scientific information, and to give unity to sketchy and fragmentary representations, re-placing them in a context, and bringing out the link between the illness, the people, forms of behaviour, and oneself.

The Children's Questions

After children had filled in the questionnaire, they were invited to ask any questions they wanted to freely and anonymously, so that the educators could answer them in the second part of the session. Another form had been prepared for this and annexed to the questionnaire. Our aim here was to make the children put their questions in written form before the informational presentation, as well as to give us a representative body of questions, and to define these precisely before providing answers.

While the children were at break, their questions were written out again, with no modification whatsoever. After break, the children were put in single-sex groups in separate rooms, so as to make it easier for them to communicate, and to reduce the difficulties associated with talking about genitality and private concerns, which, in a mixed group, greatly disturb children's expression. Their regular teachers were not also present for the same reasons. The health educator read out the question and asked the group to respond, only taking part to give more information to substantiate an answer, to get the children talking again, or to regulate the exchanges and make sure that everyone participated. An answer was given for every question as long as it had been asked by the children.

Our ethical approach was to use only the vocabulary from the presentation or that used by the children, excluding any words or expressions coming from adolescent or adult vocabulary, particularly in the field related to the management of sexuality. This was essential as we had realized that unfamiliar words coming from adult or adolescent vocabulary about sexuality inhibited communication and thwarted our objectives. However, by using in our answers exactly the same expressions and words that the children used to their, sometimes, very direct questions about sexual practices, we could show the children that any subject can be tackled. The educator's role was mainly to get the discussion going, to modify, or to substantiate the representations by clarifying points, and, if necessary, to offer extra help in completing fragmentary or sketchy knowledge.

Teaching Tools

The card game in the first session: The card game was devised for this experiment and for this particular group. It was based on the approach developed for

adolescents (Ricard, 2000) and on the results of the pilot study. It included situations in daily life concerning both close relationships with affected people, and more distant situations, so that the children could express their certainties and doubts, and the rumours they had heard. The rules were simple. Each child was given some cards. He read out what was written on the card, showed it to the group, and put it down on one of three cards which indicated no risk, I do not know, or high risk. The child explained his choice and then asked the group to say what they thought. This approach enabled us to involve all the children, even the shyest, and gave them room for expressing themselves.

Role playing game in the second session: The aim of this activity was to get the pupils to talk about HIV/AIDS using a different point of view from their own. They had to take the role of parents, teachers, and children in a concrete situation. Through this, we intended to put the children in a situation where they could express, and become aware of their own representations of the pandemic, the risk of infection, and the ways to protect themselves. This projected identification had a powerful emotional component.

Final written work: The children dictated to the educator an account of what they had done, or of the ideas and things which they felt to be important, and which they, therefore, wanted to share with their families and class teacher. The advantage this strategy had over an individual account was that it did not put the children in a difficult school situation by asking them to write. It also made it possible to summarize what was essential.

Results

Statistical Analysis

The questionnaires were processed by the statistics department at the St Etienne School of Medicine, according to the thesaurus drawn up, when we did the pre-test. Epi info 5.01 and SPSS was used. Statistical significance was estimated at $p < 0.05$. When the size of samples was small, the adjusted Khi2 (Yates method) was used and, if the size of one of the samples was beneath 5, we kept the results given by Fisher's test. The analysis was only univariate.

The questions asked by the children were analysed using the method of the "analysis of content" (Bardin, 1993). So, we put the answers together according to their semantic structure, and observed combined or frequential indicators (analysis of co-occurrence), which enabled us to establish links between the data (Microsoft Access).

The data described here focus on a comparative study of the results of the two questionnaires. However, the programme was also assessed by the pilot committee, the school medical staff, the teachers and the parents.

Evaluation of the Process

The pilot committee: The committee supervised the research action all the way through. They met before the sessions to validate the protocol and also defined an ethical framework based on respecting people, and respecting the children's and their families' convictions. After the first session, the results of the first set of data were presented, as well as a report written by observers from outside the team

about the way the ethical framework had been respected, and how the sessions had gone and been managed. Once the whole protocol was over, the different results and analyses were presented and discussed. All members of the committee attended regularly, including parents' associations. In the interviews, the members of the committee pointed out that their opinions had been taken into account.

Medical staff: The evaluation of the schools' medical staff (school doctors and nurses) was carried out through an anonymous individual questionnaire. The totality of the data found in this questionnaire cannot be analysed here. The results show that the medical staff found the organization relevant. After the experiment, they admitted that they felt more comfortable when tackling the issues of AIDS and sexuality in a comprehensive approach to health education for young pupils. They expressed their need for training both for updating their knowledge about HIV, but more particularly on how to teach health education, and on what theoretical and pedagogical knowledge is necessary. **Teachers:** For the teachers, an anonymous individual questionnaire was also used, and they said they were in favour of this kind of action. They insisted on how advantageous it was to build up partnerships with competent professionals who have been trained for such actions with children, not with a view of making up for insufficiencies or to replace the class teacher, but to working with the teacher on a common project that is part of their syllabus. In most cases, before the intervention, they found it hard, or even impossible, to talk about such matters with their pupils, although they were well aware of the need for it. The reasons they put forward were: (a) They did not have enough knowledge about the disease, the way it is caught, and what protection can be used. (They considered that the only information they had was from the media, and deemed this to be inadequate for giving precise information to the children). (b) They were afraid of how the parents might react as they considered it as a tricky subject. (c) They found it hard to tackle questions about sexuality. (d) They were worried that they might be asked questions that they could not answer. Moreover, they all stated that they had changed the way they considered having HIV positive children in their school, and felt better prepared to tackle the issue with parents and colleagues.

The parents: Parents' attendance at meetings organized in each school before the interventions varied enormously in relation to the social category involved. Families from the most under-privileged social categories attended less than the others. The aims of the meetings were to present the collaborative research project, answer any questions, and give an account of the results. Right from the start, we noted that it was not really possible to get parents from the most underprivileged schools involved, and the number of parents present was always very low. However, there was a high attendance rate for parents from more privileged schools. As a result of these meetings, it was obvious that very few parents were against early AIDS prevention, and there was not any obvious and definite opposition. The observations made by parents mainly concerned their desire for the family's religious and philosophical beliefs to be respected.

Analysis of the Questions Asked by the Children

We were able to study 350 forms. The variables which we used were gender (190 girls and 160 boys), the class at school (114 CM1 and 236 CM2), and the social class (highly privileged 88, quite privileged 103, quite underprivileged 109, and

seriously underprivileged 50). Only the first ten questions asked by each child were taken into account and analysed. During the first session, the children asked a total of 1267 questions, and during the second 759. Thus, there was a drop of 40% ($p < 10^{-3}$). The average number of questions asked in the first series was 3.62 per child, and for the second 2.16. In the first session, 95.7% of the children asked at least one question, and 73.7% in the second. The number of questions goes down significantly faster in the second series than in the first ($p < 10^{-3}$). Between the two sessions, the number of children not asking any questions goes up significantly ($p < 10^{-3}$). There were 19 in the first series and 96 in the second.

The analysis of the questions showed that the changes varied according to the item concerned. There was little or no change for the questions about the disease, "love and sexuality," anxiety, the fight against AIDS, and living with the virus. But, there was a significant decrease in the number of questions concerning the modes of infection ($p < 10^{-3}$) and protection behaviours ($p = 0.025$). The questions on protection, anxiety, attempts to understand, and even the questions on modes of infection, go down much more for the boys than for the girls. The children coming from severely underprivileged families still asked a lot of questions ($p = 0.03$), as did those from a highly privileged background ($p = 0.04$).

Analysis of the Questionnaires

The pupils had to fill the questionnaire before session 1 and before session 2. The results are shown in Table 1. For the closed questions, the results are expressed as percentages of the total number of questionnaires taken into account in the analysis. For open-ended questions, the responses are put together in different items and are expressed as percentages of the total number of questionnaires including an answer to the concerned question (data are given in Table 1 only if the items are cited in more than 5 % of the cases in session 1 or 2). For multiple choice questions, the total percentage could exceed 100, because children were allowed to give more than one answer. When a significant impact of gender, age, or social status on the responses was observed, it is indicated. When a significant difference was observed between second and first session, the data are in bold print.

The analysis of the first questionnaire gives an overview of the initial representations of the pupils. The results are shown in Table 1. The comparison between pre- and post-questionnaires guided us to identify where a modification of representations was observed. The analysis was performed taking into account five points: (a) knowledge about AIDS, (b) communication about AIDS, (c) knowledge about the disease, (d) knowledge about modes of infection and protection, and (e) relationships with affected people (the analysis of the other parts of the questionnaire are not shown in this article).

Knowledge about AIDS

The analysis of the first questionnaire (pre-test) indicated that more than 92% of the children had information about AIDS, while, six months later, this percentage increased to 98% for the second questionnaire. The main source of information was television (88%) followed by the family (25%). However, these results (Question 2) were inconsistent with the results from another question (Question 4), where more than 65% of the children stated that they had talked about AIDS

Table 1
Analysis of the Questionnaires

		SESSION 1		SESSION 2	
Questions	Answers	Impact of gender, age or social status	Answers	Impact of gender, age or social status	
General representation of HIV/AIDS					
Have you already heard of AIDS ?	Yes : 92 % No : 8 %	No gender, age or social influence	Yes : 98 % No : 2 %	No gender, age or social influence	
If yes, where ?	<ul style="list-style-type: none"> Media (TV radio) 88 % Family 25 % Doctor 7 % School 7 % Friends 1 % 	<p>The number of non responders is higher in the group of young pupils: CM1 / CM2 (19 vs 5 %) *</p> <p>The parents are less often cited by pupils in group A than pupils in groups C* and D *</p> <p>No gender influence</p>	<ul style="list-style-type: none"> Media (TV radio) 90 % School 38 % Family 33 % Doctor 2 % Friends 4 % (the increase is only significant in the older group CM2) 	<p>The number of non responders is higher in the group of young pupils : CM1 / CM2 (7 vs 2 %) *</p> <p>The parents are less often cited by pupils in group A (8 %) than pupils in groups C (16 %) * and D (14 %) *</p> <p>No gender influence</p>	
What does AIDS make you think of ? Write three words	<ul style="list-style-type: none"> Disease 42 % Death 34 % Sexuality 9 % Protection behaviour 4 % 	<p>Concerning the item « sexuality », boys outnumbered girls (12 vs 7 %) *</p> <p>Pupils in group D give more words about sex than C, B and A *</p> <p>No age influence</p>	<ul style="list-style-type: none"> Disease 46 % Death 26 % Sexuality 11 % Protection behaviour 7 % 	<p>Pupils in group D give more words about sex than C, B and A *</p> <p>No age or gender influence</p>	
Communication about AIDS					
Have you ever talked about AIDS with adults ?	Yes : 51 % No : 49 %	Pupils in group A (29 %) had spoken less about AIDS with adults than groups B 50% C 51 % and D* 63 %	Yes : 76 % No : 24 % *	No gender, age or social influence	
With other children ?	Yes 51 % No : 49 %	No gender, age or social influence	Yes : 75 % No : 25 % *	No gender, age or social influence	
Have you talked about AIDS in your family ?	Yes 62 % No 38 %	No gender, age or social influence	Yes 76 % No 24 % *	There is an influence of social status on the impact of the training session : the increase in communication is limited to groups C, D and E*	No gender or age influence
Knowledge about HIV/AIDS					
Do you know what "Virus" means?	Yes 65% No 35%	No social, age or gender influence	Yes 67% No 33%	No gender, age or social influence	
Can you explain what Virus means ?	<ul style="list-style-type: none"> Disease 54% Microbe 31 % Vector 14% 	<p>Large number of non-responders (32% of children asking yes to the previous question) There is a gender difference, girls link "virus" with illness and boys with microbe*</p> <p>No social or age influence</p>	<ul style="list-style-type: none"> Disease 44% Microbe 36 % Vector 20 % 	<p>Large number of non-responders (47% of children asking yes to the previous question) No gender, age or social influence</p>	
Do you know what "HIV positive" means ?	Yes 35 % No 65 %	Girls says yes more often than boys (41% vs 28%)*	Yes 65 % No 35 % *	No gender, age or social influence	
		No social or age influence			

Table 1
(Continued)

Can you explain what means HIV positive means ?	Someone who is sick (AIDS) 52% Someone who has the HIV virus but is not sick 33 %, Someone with serious disease having no link with AIDS 13%	Large number of non-responders (63% of children asking yes to the previous question) Pupils in group A had spoken more about serious diseases without link with AIDS (A 33%, B 3%, C19%, D 9%)* No gender or age influence	Someone who is sick (AIDS) 49% Someone who has the HIV virus but is not sick 51 % * Someone with serious disease having no link with AIDS 0%	Large number of non-responders (40% of children asking yes to the previous question). There are more responses concerning the virus in the older group (CM2) 36% than in the younger one (CM1) 15% * No social or gender difference
How can we know if we are HIV positive ?	Active solutions 80% Passive solutions 20% 7 children said there is no way to know if you are HIV positive	Group A (72%) suggests fewer active solutions than B 81%, C 78%, D 87%* No gender or age influence	Active solutions 93% Passive solutions 7% * no children said there is no way to know if you are HIV positive	Girls suggested fewer active solutions than boys * Group A suggest fewer active solutions than the others group* No age influence
Assessment of modes of infection and protection				
Is AIDS a transmissible disease?	88% of the pupils consider AIDS as a transmissible disease	No gender, age or social influence	97 % of the pupils consider AIDS as a transmissible disease *	No gender, age or social influence
If yes ? What gives you AIDS ?	Number of words per pupil = 1.28 Things (sperm, secretions, drugs) 58 % Behaviour (sexual intercourse, using drugs...) 28% Condition (illness, poverty...) 6% God, evil, sin, fate 5%	Pupils in group D give more words about sex 66% , than C 55%, B 55% and A 28%* There are more responses with older pupils (CM2) 90% than younger (CM1) 76% No gender difference	Number of words per pupil = 1.72 * Things (sperm, secretions, drugs) 36 % * Behaviour (sexual intercourse, using drugs...) 59%* Condition (illness, poverty...) 3% God, evil, sin, fate 0%	No gender, age or social influence
Is AIDS an illness we can avoid?	Yes : 90% No: 10%	No gender, age or social influence	Yes : 98% No: 2% *	No gender, age or social influence
How can you protect yourself? 3 words	Number of words used : 1.05 Using condom : 68% Avoidance behaviour : 11 % Protection behaviour : 5 %	No gender, age or social influence	Number of words used : 1.37 * Using condom : 91 % * Avoidance behaviour : 6 % Protection behaviour : 3 %	No gender, age or social influence.
At what age can you get Aids ?	Teenagers : 45 % Throughout life : 24% Childhood : 15 % Adult : 9 % (Never : 1%)	No gender, age or social influence	Teenagers : 32 % * Throughout life : 40% * Childhood : 16 % Adult : 2% * (Never : 0%)	No gender, age or social influence
Life with affected people				
Have you heard of anyone with AIDS ? If yes, where?	Yes 47% No : 56 % Media 81% Family: 11%	No gender, age or social influence No social, age or gender influence	Yes 46% No 54% Media : 87% Family : 6%	No gender, age or social influence No gender, age or social influence
Can you live with someone with AIDS without any risk for yourself ?	Yes 36% No 64 %	No gender, age or social influence	Yes 71% No 29% *	No gender, age or social influence
Is there a risk for me if a classmate is HIV positive ?	Yes 41% No : 59%	No gender, age or social influence	Yes 14% No 86% *	No gender, age or social influence

with their families. The only source of information which changed significantly between the two questionnaires was the school ($p < 10^{-3}$). Children mainly associated AIDS with words suggesting, Illness, Death, and Sexuality. They also mentioned, to a lesser extent, condoms, blood as a vector for infection, drug-taking, and finally prevention, and solidarity. The intervention did not trigger off any substantial change in initial associations with Illness/Death/Sex, but it nevertheless allowed most children, who had not talked of the subject, to be involved in discussions about AIDS. Three-quarters of those who did not mention anything initially, they actually spoke up after the intervention. Thus, the highly privileged group D referred initially to sex and sexuality more than the severely underprivileged group A ($p < 10^{-3}$). But, this difference was much smaller at the end of the session ($p = 0.05$).

Communication about AIDS

Figure 2 shows the differential influence of socioeconomic status on the impact of communication about AIDS with adults (Have you ever talked about AIDS with adults?) and in the family (Have you talked about AIDS in your family?). If the increase in communication with adults concerned the 4 groups, it was limited to the underprivileged, privileged and highly privileged groups for communication inside the family. Results are expressed as percentages of the total number of questionnaires including an answer to the question.

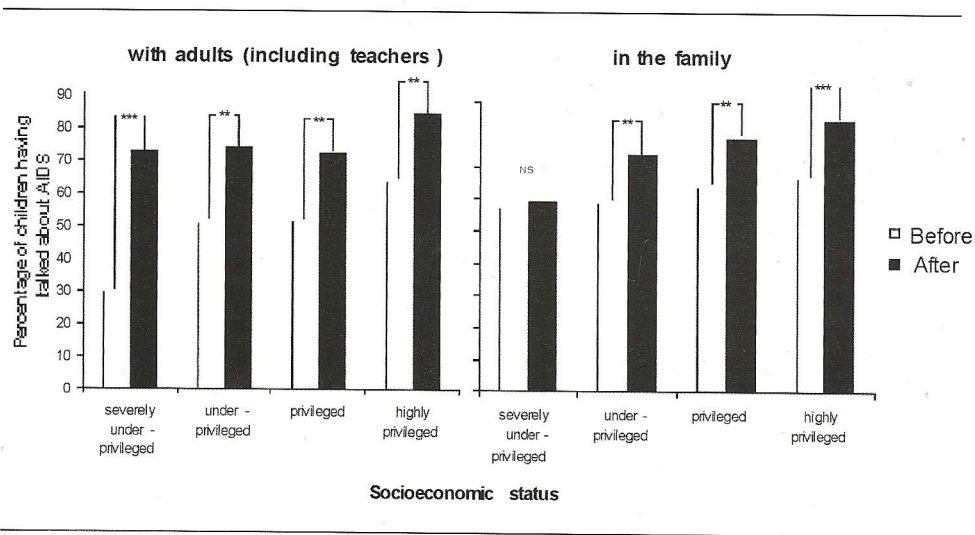


Figure 2. Influence of Socioeconomic Status on the Impact of the Intervention on Communication about AIDS. (* $p < 0.05$ ** $p < 0.01$, *** $p < 0.001$).

Pupils communicated about AIDS with adults, with friends and at school. Fifty percent of the children have talked about AIDS with adults before the intervention. At the end, 76 % of them have talked about the subject with adults, either before the first session or between the two. The intervention did not bring any significant increase in communication within the family in the severely underprivi-

leged group ($p=0.3$, 49%), unlike in the other groups, where there was a significant increase with 74%, 79% and 85%, for groups B, C, and D with $p=0.01$, $p=0.01$, and $p=.001$, respectively, indicated that communication between the pupils was also enhanced.

Knowledge about the Disease

Before the intervention, more than half of the children associated AIDS with a fatal illness. On a scale ranging from 0 to 10, the children rated the dangerousness of AIDS at more than 8. Population A alone stands out by assessing its gravity at less than 8 ($p=0.007$). The illness which is symbolically associated with AIDS is cancer. Infectious illnesses are not often quoted, and only 5% of the children mention Hepatitis B. After the intervention, we found that references to infectious diseases dropped considerably, and associations with childhood illnesses disappeared. Two-thirds of the children stated that they knew what a virus is, and could give a relevant explanation, with a definition based on one of three 'concepts': a microbe, an illness, or a vector of an illness. However, only a third of them knew what HIV positive means.

Modes of Infection and Protection

Before the intervention, 88% of the children associated AIDS with a transmissible disease, and 97% after the intervention. The change was slight but significant. In the pre-test, 74% of the children answered the question "What gives you AIDS?" and in the post-test 89%. For the children, AIDS is transmitted by vectors: secretions (sperm), sex, drugs, and the HIV virus; and by behaviour: sexuality, drug-addiction, and medical practices related to the handling of blood, such as, transfusion and giving blood. Drug addiction was scarcely mentioned, and references to syringes or exchanging syringes were very uncommon. Similarly, references to materno-foetal transmission, and to incorrect vectors, such as, saliva, mosquitoes, daily actions, morality, or God, were almost non-existent. The lexical field used was fairly limited, but it was wider in the second session. The question was put in such a way as to give the children the possibility of replying by designating supposedly high-risk groups (homosexuals, prostitutes, drug-addicts, dirty people, and others). Children did not consider that people identified as 'deviant' were responsible for beginning the infection. As far as modes of infection are concerned, after the intervention there was a modification in the trend concerning the answers about vectors of infection, and those about behaviour. Representations definitely became clearer. Before the sessions, more than half the children explained that contamination came from vectors: sex (1/2) and drugs (3/4), but after the session, they referred to "dangerous" behaviour (90% sexuality and 50% also mentioned drug-addiction). Preventive action modified representations concerning modes of infection ($p=0.001$). However, this reversal was less obvious for the very underprivileged social categories ($p=0.03$).

In order to know whether an individual may have been infected, more than half the children suggested active solutions, such as, having a test, or going to see a doctor. Fifteen percent suggested passive solutions, waiting for the symptoms to appear, or waiting till you feel ill. The girls suggested fewer active solutions than the boys ($p=0.013$), and the severely underprivileged children fewer than the highly privileged ($p=0.049$). After the intervention, reference to detection increased con-

siderably ($p=0.002$), and there was less talk of adopting a passive stance or waiting for symptoms to appear ($p=0.016$).

Prior to the intervention, 68 % of the children suggested the condom as a way to be protected, and this percentage increased to 91% afterwards. The intervention mainly gave rise to a considerable increase in references to condoms, protection, and avoidance. There were no statistically significant difference related to age, sex, or social status.

Relationship with Affected People

One in two children had heard of someone who had or has had AIDS, both before and after the intervention. Only one in ten has heard of it through a channel other than television. Before the intervention, 64% of the children thought it was dangerous to live with an HIV positive person. Twenty-nine percent continued to think so, even afterwards, but there was a significant change in the way infected people are seen and in the perception of the absence of risk of infection in everyday life.

Discussion

The aim of our study was to identify the initial representations of pupils on AIDS/HIV and to analyse the impact of an educational programme based on regular teacher's activities and interventions of health educators on these representations, on communication about AIDS/HIV, and on the way in which infected people are seen. The main features of our study were its target (young pupils aged 9 and 10), the close partnership between teachers and health educators, the involvement of parents, and the fact that it was based on a learner-centred model (the allosteric model as described by Giordan, 1995). First, we are going to discuss the relevance of such a research design and, secondly, we will analyse the pupils' initial representations on AIDS/HIV and the impact of the program. Finally, the issue of communication about AIDS in the family and with peers will be addressed.

The main characteristic of collaborative research is the close involvement of the target population in the development and management of the program, or, in other words, the closeness between researchers and actors (Martinand, 2003; Merini, 2005). It also aims at an improvement of practices here and now. Our study shows the interest of such a design in AIDS/HIV prevention. Indeed, the participation of actors (teachers, parents, doctors, nurses etc.) in the programme was high and sustained throughout the two years. The intervention also took place in a coherent way in the educational environment of the pupils. In addition, the design guided us to take into account the ethical issues linked to a preventive intervention (respect for people, cultures, family upbringing etc.) Nevertheless, we must also underline the limits of such a design. It was time consuming and the involvement of the severely under-privileged group was lower than that of the other groups.

As described in previous studies (e.g., Anochie & Ikpeme, 2003), the analysis of the initial questionnaires indicated that 9- and 10-year-old children did have representations of the HIV pandemic, the people affected, and the modes of infection and protection, but they had incomplete information on the subject. More than half associated AIDS with a fatal illness as serious as, or more serious than cancer,

transmitted by 'sex,' and 'caught' especially by adolescents and adults. The illness can be avoided by putting on a condom (68 %), and detected by 'tests' or going to 'see a doctor' (80%). The content of their scientific statements was still at times completely or partially incomprehensible, as they could not fit them into a more general conceptual framework of knowledge, which would allow overall understanding (Kirb, Short, Collins, Rugg, Kolbe, Howard, 1994; Kirby, 1995; UNAIDS 1997). It can be noted that the highly privileged group D referred to sex and sexuality more than the severely underprivileged group A. It was also evident that the severely underprivileged children generally used a much more limited lexical field than the others. This observation was evident in the questionnaire as well as in the analysis of the transcripts of work in sub-groups. This lexical limitation seemed to have interfered with establishing complex representations, and these pupils could not avoid a reductive over-simplification.

At the end of the session, more children answered most of the open questions, and did so using more words. The lexical field concerning biomedical knowledge was of higher quality. As far as modes of infection are concerned, we could see a reversal in the trend concerning the answers about vectors of infection, and those about behaviour. Before the sessions, more than half the children explained that contamination came from vectors, such as sex or drugs, but, after the session, they mainly referred to dangerous behaviour (sexuality, drug-addiction). As for protection, the study indicated the impact of the prevention programme. At the end of the sessions, only 8 children answered that you cannot avoid catching AIDS. There was a 150 % increase in the number of children stating that "the condom protects you from HIV infection." Three times more children spoke about protective behaviour. These data have to be taken carefully into account, because it is well known that there is no direct link between knowledge and behaviours (e.g., UNAIDS, 1997).

In addition to the influence of socioeconomic status on children's representations, we observed an influence of age and gender. The representations of the 10-year-olds were more relevant than the 9-year-olds, who are still quite childish. Researchers working on representations in children of different ages also made a similar observation (BMA, 1997; UNAIDS 1997; Brown 1990). However, there is little difference between girls and boys (du Guerny & Sjoberg, 1993; Guthrie, Wallace, Doerr, Janz, Schottenfeld, Selig, 1996; Prah Rugger, 2004; UNAIDS, 2004).

The study also investigated communication about AIDS. People with whom pupils speak about AIDS were mainly their families and peers. Nevertheless, in the second question, 1 %- 4 % of them stated that they had never heard their friends talking about AIDS. In a study performed with primary school children (11-year-old). Anochie and Ikpeme (2003) had also shown that friends were not an important source of information for pupils (4 %). It is not easy to interpret this statement, as, in question 3, 44% of the same children stated that they have talked about AIDS with other children. Maybe this is a sign of a distortion caused by a devaluing of this source of information in favour of sources, which they interpreted as more knowledgeable. It is highly likely that the children had heard more about AIDS through the media than from their friends, which caused them to underestimate the importance of the information they got from their peers. Moreover, the children discounted this information as not being serious and,

therefore, not worth mentioning, in comparison with information given by experts on the TV, 'which tells the truth.' This point also proved to be valid with the analysis of the work done in the sub-groups of the study.

About 62% of the children have talked about AIDS in their families before the intervention whatever their age, sex, or social origin. In the second series, 76 % of them have talked about the subject with their families, either before the first session or between the two. But our intervention did not bring any significant increase in communication within the family in the severely underprivileged group. These data show how hard it is to get a family to talk about AIDS, particularly for the severely underprivileged, and raises the question of family communication in the field of health education. It is likely that the intervention triggered discussion in families where there was a readiness for this. Our analysis shows that more than 90% of the families of the underprivileged group were of foreign origin (North African and Turkish). Talking about sexuality, especially with boys, in a cultural framework that was profoundly steeped in tradition, meant adopting a new Western-style cultural position. So, it was difficult to talk about such a private subject in the family. The priority was not denying one's origins, and preserving an identity, so as not to be swallowed up by integration, which was experienced as culturally destructive. So, no standard model of intervention could be put forward, the cultural dimension was a significant variable in actions and their impact (Rosenthal, 1990; Tones & Tilford, 2001; WHO 1997, 2004a, 2004b). The whole community must really be involved when the intervention occurs in a multicultural environment.

The analysis of the interviews indicated that communication about AIDS in families and between friends was related to an external stimulus, generally the media (but sometimes school). Television news and special programmes made families react. Families who tackled the issue without any direct link with the media were only few and far between. When they did, it was more frequently to warn children about the risks of sex and drugs than to incorporate this into a more general discussion about exclusion, life, its risks and the management of these, sexuality, and pleasure.

The cross analysis of the questions showed that in the situations described, where the question of the integration of an HIV positive person was raised, the attitude of children from families where AIDS was discussed was no different from that of children from backgrounds where it was not. So, it would seem that the family message did not focus on the integration of infected persons. Nor was it a message of exclusion. It was likely that the parents' message did not concern infected people. The reality of the infected person remained largely virtual. Information mainly came from the mass media and television, and contact with sufferers in their daily lives was rare.

Conclusion

This study shows an evolution in the representations of pupils about HIV/AIDS. The intervention led them to build new representations that take more objective facts into account. These results are interesting but have to be discussed with humility, as it is well known that there is no one to one link between knowledge and behaviour. The mere provision of knowledge is not enough if the aim is

a relevant scientific education, but the educational process here includes helping children "to clarify their values in relation with themselves health, health-influencing behaviours" (Downie et al., 1996). In addition, such an intervention makes it possible to talk much more about a much broader spectrum of themes related to health. In working on HIV/AIDS prevention and sexuality education, numerous other aspects of science education are tackled, and mainly the status of science in relation to the everyday life (nature of science and scientific knowledge, application of science concepts, values that underlie science etc.) By offering an HIV/AIDS education programme, it is possible to promote a comprehensive health approach (St Leger & Nutbeam, 1999), only if the whole educational environment is involved, the intervention is really learner-centred, the programme is sufficiently open and does not aim at enforcing some form of behaviour, and the ethical framework is clearly defined. Such an approach, to be effective, must take into account the complexity of health, and the factors which influence it, but also actual science education theory and practice. This last point is decisive as one of the most important difficulties in implementing relevant programs is, in addition to taking into account cultural and social diversity, the involvement of teachers and school staff (Ayo-Yusuf, 2001; Han & Weiss, 2005).

References

- ABRIC, J.-C. (1997). *Pratiques sociales et représentations* (2nd edition). PUF. Paris.
- ANOCHIE, I., & IKPEME, E. (2003). AIDS awareness and knowledge among primary school children in Port Harcourt metropolis. *Niger Journal of Medicine*, 2003 (1), 27-31.
- AYO-YUSUF, I., NAIDOO, S., CHIKTE, U. M. (2001). The role of primary school teachers in HIV prevention in South Africa. *SAD*, 12, 596-598.
- BARDIN L. (1993). *L'analyse de contenus*, PUF, Paris.
- BERGER D., COLLET R., LAQUET-RIFFAUD A., & JOURDAN D. (2003). Quelles représentations les enfants ont-ils du SIDA ? Contribution d'une recherche-action en éducation pour la santé auprès de classes de CM1 et CM2. *En question*. 48. 1-29.
- BMA Foundation for AIDS. (1997) *Using effectiveness research to guide the development of school sex education*. London: British Medical Association.
- BROWN M. D., NASSAU J. H., & BARONE V. J. (1990). Differences in A.I.D.S. knowledge and attitudes by grade level. *Journal of School Health*. (60)6, 270-275.
- DARROCH J., & SILVERMAN J. (1989). What public school teachers teach about preventing pregnancy, A.I.D.S. and S.T.D. *Family Planning Perspective*, (21)2, 65-73.
- DES JARLAIS D., LYLES C., CREPAS N., & TREND group (2004). Improving the reporting quality of nonrandomized evaluations of behavioural and public health interventions: The TREND statement. *American Journal of Public Health*, 94(3), 361-366.
- DOISE W., & MUGNY J.P. (1984). *Le développement social de l'intelligence*. Oxford: Pergamon Press.
- DOWNIE R. S., TANNAHILL C., & TANNAHILL A. (2004). *Health promotion: Models and values* (2nd edition). Oxford: Oxford Press.
- DU GUERNY J., & SJÖBERG E. (1993) Inter-relationship between gender relations and the HIV/AIDS epidemic: Some possible considerations for policies and pro-

- grammes. *AIDS*, 7, 1027-34.
- FARR R. (1997). Les représentations sociales. In *Psychologie sociale*. S. Moscovici. (dir.) PUF Editor Paris.
- FASSLER D., MC QUEEN K., DUCAN P., & COPELAND L. (1990). Children's perceptions of A.I.D.S. *J. Am. Acad. Child adolesc. Psychiatry*. (29)3, 459-462.
- FERRON C., FEARD S., BON N., SPYCKERELLE Y., & DESCHAMPS J-P. (1989). L'enfant et le SIDA, connaissance et représentation, *revue française de pédiatrie* (XXV), 195-209.
- FISCHER G.N. (2001). *Les concepts fondamentaux de la psychologie sociale*. Paris: Dunod Editor.
- GIORDAN A. (1995). New models for the learning process: Beyond constructivism. *Prospects*, XXV(1), 101-118.
- GIORDAN A. (2000) Health Education, Recent and Future Trends. *Mem Inst Oswaldo Cruz.*, 95(1), 53-58.
- GUTHRIE BJ, WALLACE J, DOERR K, JANZ N, SCHOTTENFELD D, & SELIG S. (1996). Girl Talk: Development of an intervention for prevention of HIV/AIDS and other sexually transmitted diseases in adolescent females. *Public Health Nursing*, 13, 318-30.
- HAN S.S., & WEISS B. (2005) Sustainability of teacher implementation of school-based mental health programs. *J Abnorm Child Psychol*, (33)6, 665-79.
- HEYMANS A. (1993). Prévention, sexualité, SIDA qu'en est-il pour les enfants ? in *Les jeunes face au SIDA de la recherche à l'action* A.N.R.S. Editor. Paris. 94-100.
- INSEE (2004). Nomenclatures et codes. Les nomenclatures des professions et catégories socioprofessionnelles; Liste des catégories socioprofessionnelles agrégées 2003. *La documentation Française*. Paris.
- JODELET D. (1991). *Les représentations sociales*. Paris: PUF Editor.
- JOURDAN, D., PIEC, I., AUBLET-CUVELIER, B., BERGER, D., LEJEUNE, M. L., LAQUET-RIFFAUD, A., GENEIX, C., & GLANDDIER, P. Y. (2002). Education à la santé à l'école: pratiques et représentations des enseignants du primaire. *Santé Publique*, 14, 403-423
- KELLY J. (1995). Advances in HIV/AIDS education and prevention. *Family Relations*. 44, 345-52.
- KIRBY D, SHORT L, COLLINS J, RUGG D, KOLBE L, & HOWARD M, (1994). School-based programs to reduce sexual risk behaviors: A review of effectiveness. *Public Health Reports*, 109, 339-60.
- KIRBY D. (1995) *A review of educational programs designed to reduce sexual risk-taking behaviors among school-aged youth in the United States*. ETR Associates. Santa Cruz.
- KIRBY, D. (2002). Effective approaches to reducing adolescent unprotected sex, pregnancy, and childbearing. *J. Sex. Res*, 39(1), 51-7.
- MARTINAND J.L., (2003). Les savoirs entre pratique, formation et recherche. *Recherche et Formation* (40).
- MERINI C. (2005). Travail conjoint et professionnalité enseignante *Rapport d'étude IA 92- UIMM Mai 2005* ADASE, Paris.
- MEN (Ministère de l'éducation nationale) (2002) BO hors série n°E1 du 14 février 2002
- MEN (Ministère de l'éducation nationale) (2003) L'éducation à la sexualité dans les écoles, les collèges et les lycées BO n°27 du 17 février 2003

- PRAH RUGER J. (2004) Combating HIV/AIDS in developing countries *BMJ* (121)329;121-122.
- RICARD E. (2000) Sida que savons-nous? 33 cartes pour en parler. *Transcriptase Sud.*, 3, 19-20.
- ROSENTHAL D, MOORE S, & BRUMEN I. (1990) Ethnic group differences in adolescents. *Australian Journal of Social Issues*, 25, 220-39.
- SCHAALMA H, KOK G., & PETERS L. (1993). Determinants of consistent condom use by adolescents: The impact of experience of sexual intercourse. *Health Education Research*, 8, 255-69.
- SCHONFELD D. J., JOHNSON S. R., PERRIN E. C., O'HARE L. L. & CICCETTI D. V. (1993). Understanding of A.I.D.S. by elementary school children – A developmental survey *Pediatrics*, (92)3, 389-395.
- SLY D. F., EBERSTEIN I. W., QUADANO D., & KISTNER J. A. (1992). Young children's awareness, knowledge & beliefs about A.I.D.S.: observations from a pretest, *A.I.D.S. Education & Prevention*. 4(3), 227-239.
- ST LEGER, L. AND NUTBEAM, D. (1999) Evidence of Effective Health Promotion in Schools. In Boddy, D. (ed). *The Evidence of Health Promotion Effectiveness: Shaping Public Health in a New Europe*. Brussels: European Union.
- THOMAS P. (1991). "Chat-SIDA", une recherche-action en éducation pour la santé avec des enfants de CM2 d'Argenteuil. *Thesis for the C.E.S. de psychiatrie. U.E.R. de médecine Broussais / Hôtel-Dieu*. Université Paris VI.
- TONES K. & TILFORD S. (2001). *Health Promotion effectiveness, efficiency and equity* (third edition). Cheltenham: Nelson Thornes Editor.
- UNAIDS (1997). Influence de l'éducation en matière de VIH et de santé sexuelle sur le comportement sexuel des jeunes: un bilan actualisé. Geneva.
- UNAIDS (2004). AIDS and girls education. Geneva
- VICTORIA C. G., HABICHT J. P., & BRYCE J. (2004). Evidence-based public health moving beyond randomized trials. *Am. J. Public Health*, 94, 400-405.
- WHO. (1999), Preventing HIV/AIDS/STI and related discrimination an important responsibility of health promoting schools. *WHO information series on school health*. Geneva: WHO Editor.
- WHO. (2004a). Guide to Monitoring and Evaluating National HIV/AIDS Prevention Programmes for Young People - Addendum to the UNAIDS "National AIDS Programmes: A Guide to Monitoring and Evaluation". Geneva.
- WHO. (2004b). Participatory Learning Activities from the EI/WHO Training and Resources Manual on School Health and HIV and AIDS Prevention. Geneva.
- WHO. (1997). *Promoting health through school*. Geneva

Acknowledgments

Authors thank Rémi Collet for his contribution to the research.