

People's Ideas about Climate Change: A Source of Inspiration for the Creation of Educational Programs

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Abstract

The global nature of the phenomenon, the complexity of climatic knowledge, and the difficulty of modifying human behaviour complicate the choice of efficient strategies in climate change education. A qualitative study conducted with children, teenagers, and adults allowed researchers to discover people's ideas (knowledge, opinions, feelings) about the phenomenon: adults, some teenagers, and few children have heard of climate change. Participants can describe the problem without being able to identify its causes and consequences. Climate change arouses little worry because many participants estimate that the phenomenon will have no tangible consequences on their life. Teenagers are less confident than adults regarding the possible mobilization of the population to decrease their impact on the climate. Finally, educational strategies trickling down from these results are proposed.

Résumé

La nature planétaire du phénomène, la complexité du savoir climatique et la difficulté de modifier le comportement humain complexifient le choix de stratégies efficaces pour l'éducation environnementale. Une étude qualitative menée auprès d'enfants, d'adolescents et d'adultes a permis à des chercheurs de découvrir les idées des gens (connaissances, opinions, sentiments) au sujet de ce phénomène : les adultes, quelques adolescents et peu d'enfants ont entendu parler du changement climatique. Les participants peuvent décrire le problème, mais sont incapables d'en identifier les causes et les conséquences. Le changement climatique suscite peu de préoccupation parce que plusieurs d'entre eux estiment que le phénomène n'aura pas

d'incidences tangibles sur leur vie. Les adolescents sont moins confiants que les adultes quant à la mobilisation possible de la population pour réduire son apport aux problèmes climatiques. Enfin, à partir de ces résultats, on propose des stratégies pour l'éducation.

In the last three years, the Canadian government has distributed funds to organizations for the creation of climate change education programs. This type of education probably represents the most important challenge met by environmental educators, since the Tbilissi Conference in 1977. However, several factors complicate the choice of educational interventions meant to increase the awareness of school and social groups about climate change, and involve them in individual and community actions. These factors are:

- the global nature of the phenomenon making it difficult to observe at a local level,
- the difficulty associated with teaching notions of climatology,
- the diversity of viewpoints held by specialists (pertaining to the causes, previsions of global warming, etc.) that can sow doubt and sabotage the will to get involved,
- the age of the young learners, limiting their capacity to compare today's climate with yesterday's,
- the difficulty associated with modifying behaviour anchored in living habits (use of the automobile and overconsumption of manufactured goods),
- the less frequent contact of people with their natural milieu thus crippling individual awareness of biophysical change,
- the phenomenon's far future dimension contributing to the decrease of such preoccupations, and
- the high number of environmental problems and their interdependency that can discourage the spirit of initiative and confound learners.

With the goal of elaborating educational tools responding to the above factors, and with a socio-constructivist perspective, researchers at the Université de Moncton and the Biosphere Museum in Montreal interrogated various age groups to identify their ideas (for example, knowledge, impressions, opinions, and feelings) about climate change. Third-grade schoolchildren were the first target group selected, too young to truly have observed a different climate, but susceptible to having heard about it in the media, at school, and from their parents. The other participants were

teenagers, 13 or 14 years of age, suspected of being more familiar with the question, and adults supposedly informed by the media. In this article, we will first present the method and results of this qualitative study conducted with 158 participants in the cities of Moncton, New Brunswick and Montreal, Québec. Educational strategies for climate change education are then proposed.

Method

The choice of location for conducting the study was influenced by technical reasons. In the two chosen cities, people had already been exposed to extreme weather events, considered as possible manifestations of the phenomenon: the freezing rain crisis in Montreal and the disastrous flooding caused by the melting of ice flows in Moncton. The two cities were of different sizes, Moncton a rural municipality and Montreal a heavily populated metropolis—the comparison seemed promising. The time of year also made for a judicious choice since most interviews were conducted at the end of winter and beginning of spring, at a time when meteorologists were pointing out changes in the average temperatures: a shortened winter and tardy spring.

Interviews lasted around 30 minutes and were conducted with two classes of third-graders, one in Montreal and the other in Moncton. Similarly, 28 seventh-grade students were interrogated in both cities. As for adults, 27 in Montreal and 27 in Moncton were carefully selected so as to obtain a sample including various age groups and socio-economic levels.

The interview guide's open questions had to do with the description of the climate change phenomenon, its causes, manifestations (tangible signs in the milieu), the previsions of participants regarding global warming, possible consequences in their lives, their preoccupations and impressions on the subject, and actions that could slow down the problem. Specific questions on the greenhouse effect were also formulated. The goal of the semi-structured interviews was to describe the images people had constructed of the phenomenon. What was going on with the temperature? Why? Was global warming occurring? Would the phenomenon affect their daily lives? Could human action improve the situation? Could the general population be mobilized to change its behaviour? The interview guide was validated with other participants, and then adapted for use with different ages and regional dialects.

The interviews were conducted at the schools for the third-grade students in both Montreal and Moncton, as well as for the seventh-grade students in Moncton. The other interviews were conducted in public places such as urban parks, shopping malls, and the workplace. The participants' enthusiasm in discussing the phenomenon was remarkable and allowed researchers to obtain sincere and elaborate answers.

Interview data was analysed by two researchers with the help of the qualitative Atlas-Ti software which is used to create categories, draw links between categories, and count the frequency of categories' appearance. The two coders proceeded with the analysis individually, then compared their results in order to come up with a synthesis.

Results

The rich data collected from the interviews could provide for different analyses and interpretations including: the ideas of each age category on the greenhouse effect, an in-depth comparison between the two cities' regions, and a study of the evolution of feelings of empowerment from childhood to adulthood. In this article, however, we chose to present a general description of people's ideas about climate change.

Description of the phenomenon

Looking at Table 1, we first note that elementary knowledge of climate change is present in all adults, but that that knowledge decreases based on the participant's age. The young students and a small portion of the teenagers have never heard of climate change or global warming. No matter how the question was asked, these participants were unable to talk about the phenomenon.

Having heard of it	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
Yes	37.5%	25.0%	92.9%	75.0%	100.0%	100.0%
No	62.5%	75.0%	7.1%	25.0%	0.0%	0.0%

Table 1. Having heard of the phenomenon.

Table 2 then shows how people described these changes in the climate. In general, the ideas of people who have heard of the phenomenon are close enough to scientists' descriptions: general warming, unpredictable temperatures, decrease in snow precipitations, increased rainfall and frequency of storms, floods, etc. Some ideas, however, show confusion relating to

the phenomenon: the normal change of seasons and the presence of volcanoes for example. In children’s and teenagers’ answers, we can identify confusion between climate change and the normal passage from one season to another. So for those six participants, climate change does not correspond to a problem. However, for the teenagers that predicted volcanic eruptions, the phenomenon presents a very real danger.

People’s ideas	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don’t know	62.5%	75.0%	7.1%	25.0%	0.0%	0.0%
General increase in temperature	20.8%	0.0%	7.14%	14.3%	63.0%	48.1%
Unpredictable changes in weather	12.5%	8.3%	14.3%	17.9%	18.5%	7.4%
Early spring and tardy autumn	4.2%	4.2%	0.0%	0.0%	22.2%	22.2%
Less snow in the winter	4.2%	8.3%	7.1%	0.0%	18.5%	33.3%
Reverse temperatures: colder summers and warmer winters	8.3%	8.3%	0.0%	17.9%	7.4%	0.0%
More storms	0.0%	0.0%	0.0%	10.7%	7.4%	3.7%
The normal change of seasons (after the winter comes the spring...)	0.0%	8.3%	0.0%	14.3%	0.0%	0.0%
More rain	4.2%	4.2%	0.0%	3.6%	0.0%	7.4%
Less rain	0.0%	0.0%	0.0%	0.0%	3.7%	7.4%
Floods	0.0%	0.0%	0.0%	7.1%	0.0%	0.0%
Presence of volcanoes	0.0%	0.0%	0.0%	7.1%	0.0%	0.0%

Table 2. What’s happening with the climate.

Table 3 presents the spontaneous responses of participants to the question, “In your opinion, what causes climate change?” Here, we note a great diversity in answers, some closer to scientific theories, others, to magic. Many participants do not seem to possess a precise enough image to describe the causes of the phenomenon. Many children and teenagers, as well as an important proportion of adults, attribute climate change to pollution without further explanation. Other causes proposed by scientists and presented by the media were invoked by a few individuals: solar expansion, change in the rotation axis of the Earth, melting of the icecaps, nuclear testing, forest cutting, and El Niño, etc. Children and teenagers also offer spontaneous and sometimes amusing conceptions:

- pollution multiplies the heat of the sun,
- clouds cool the Earth during the night,
- intermix of warm and cold air, and
- the lack of equipment in the past to pick up snow makes it seem like there is less today than there used to be.

Causes	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	79.2%	91.7%	10.7%	57.1%	11.1%	11.1%
Pollution, dirt (without further details)	8.3%	0.0%	78.6%	21.4%	37.0%	29.6%
Thinning of ozone layer	0.0%	0.0%	7.1%	17.9%	18.5%	44.4%
Over production of CO ₂	0.0%	0.0%	0.0%	3.6%	22.2%	25.9%
Pollution is hot and increases the warmth of the sun	0.0%	0.0%	10.7%	0.0%	0.0%	0.0%
Atomic bombs or NASA	0.0%	0.0%	0.0%	3.6%	7.4%	3.7%
Natural and not caused by humans	0.0%	0.0%	0.0%	7.1%	3.7%	7.4%
The Earth's rotation axis has changed	4.2%	0.0%	0.0%	7.1%	7.4%	3.7%
Pesticides and chemicals	0.0%	0.0%	0.0%	0.0%	7.4%	0.0%
The sun getting bigger	0.0%	4.2%	0.0%	0.0%	0.0%	0.0%
The melting of icecaps	4.2%	0.0%	0.0%	0.0%	0.0%	0.0%
El Niño	4.2%	0.0%	3.6%	0.0%	0.0%	0.0%
Warm air and cold air intermixing	0.0%	0.0%	0.0%	0.0%	3.7%	3.7%
Clouds of dust block the sun and freeze the earth	0.0%	0.0%	0.0%	0.0%	3.7%	3.7%
Evaporation of water in the clouds warms the earth	0.0%	4.2%	0.0%	0.0%	0.0%	0.0%
Human expense of energy creates great heat	0.0%	4.2%	0.0%	0.0%	0.0%	0.0%
During the night, clouds come close to the lawn and ices it up	0.0%	0.0%	0.0%	3.6%	0.0%	0.0%
The lack of equipment in the past to pick up snow makes it seem like there's less today than there used to be	0.0%	0.0%	3.6%	0.0%	0.0%	0.0%

Table 3: What causes climate change.

We finally note that several participants mistake the thinning ozone layer with the greenhouse effect. Similarly, like some scientists, a few adults and teenagers, consider climate change to be a natural phenomenon and, as such, not worrisome. Table 4 now presents participants' explanations of the greenhouse effect.

Answers	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	100.0%	100.0%	6.07%	96.4%	48.1%	4.44%
A hole in the ozone layer allowing more sunlight to penetrate it	0.0%	0.0%	14.3%	0.0%	22.2%	22.2%
Pollution creates a layer of dust and heat gets trapped under it	0.0%	0.0%	21.4%	0.0%	3.7%	18.5%
Explanation in keeping with that of scientists	0.0%	0.0%	0.0%	0.0%	14.8%	7.4%
A layer of dust around the Earth which sunlight cannot penetrate	0.0%	0.0%	3.6%	0.0%	3.7%	3.7%
Acid rains warms the earth	0.0%	0.0%	0.0%	3.6%	0.0%	0.0%
CO ₂ cools the ozone layer	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%
Lower clouds creating smog	0.0%	0.0%	0.0%	0.0%	3.7%	0.0%
Gas cover keeping other gases from passing	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%

Table 4. What the greenhouse effect is.

Here, we first note that the fundamental cause of climate change is still rather unknown and often badly understood. The greenhouse effect is often mistaken for the thinning of the ozone layer, and sometimes with acid rain or smog. The greenhouse effect is attributed to a layer of solid waste trapping the heat or blocking solar rays. This image of solid waste around the Earth is very present in the participants' discourse. They specify that waste of various sizes rise from the Earth to the atmosphere, and that waste combines with itself to create a heat-trapping mantle. Similarly, participants that invoke the hole in the ozone layer are convinced that such a hole allows more sunrays to enter the atmosphere therefore contributing

to global warming. Results also show that people have formed various images to explain the climate change phenomenon. These images are visual (schematic), but confused with other environmental problems.

To conclude this section, it can be said that knowledge of the phenomenon increases with the age of the participant. The ideas are similar in Montreal and Moncton. The adults, some teenagers, and a few children can easily describe manifestations of climate change. However, causes are not so well known. Several participants attribute the phenomenon entirely to pollution (large waste) without further or more detailed explanations. The mental images of the greenhouse effect are varied. They tend not to conform to scientific theories and they show examples of confusion between several environmental problems.

Tangible signs of the problem and its predictability

Signs	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	91.6%	83.3%	78.5%	57.1%	37.0%	18.5%
Serious meteorological events (flooding, freezing rain)	0.0%	0.0%	3.5%	7.1%	38.5%	11.1%
Less snow on my land	0.0%	0.0%	14.2%	3.5%	18.5%	18.5%
Signs of an early spring: thaw, flowers, early opening of buds...	0.0%	0.0%	0.0%	3.5%	0.0%	37.0%
More frequent freezing and thaw	0.0%	8.3%	7.1%	7.1%	0.0%	0.0%
Unusual presence or absence of animal species	0.0%	0.0%	0.0%	3.5%	3.7%	14.8%
Differences in waterways: less water, more water, less ice...	0.0%	0.0%	0.0%	10.7%	3.7%	7.4%
Differences in plants	0.0%	0.0%	0.0%	3.5%	11.1%	0.0%
Higher temperatures	4.2%	4.2%	0.0%	3.5%	0.0%	0.0%
Different appearance of the sky	0.0%	0.0%	0.0%	3.5%	3.7%	0.0%
Sports different or played in different seasons	4.2%	0.0%	0.0%	0.0%	0.0%	3.7%

Table 5. Signs of climate change in my milieu.

Table 5 suggests that several adults, as well as many teenagers, are able to recognize signs of changes in their milieu. This capacity to identify signs is more pronounced in Moncton than it is in Montreal, possibly because of Moncton's proximity to nature and/or the slower pace characteristic of that city. People in Moncton thus seem more able to recognize modifications in the surrounding landscape. However, we also note that those in Montreal have not forgotten the freezing rain crisis of 1997.

Table 6 now offers a look at participants' situating the seriousness of global warming.

Answers	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	100.0%	100.0%	50.0%	46.4%	18.5%	25.9%
Within 11 to 20 years	0.0%	0.0%	14.3%	7.1%	3.7%	25.9%
Within 31 to 99 years	0.0%	0.0%	25.0%	0.0%	22.2%	7.4%
Within 10 years	0.0%	0.0%	14.3%	7.1%	11.1%	3.7%
Already serious	0.0%	0.0%	0.0%	7.1%	18.6%	7.4%
Within 100 years or more	0.0%	0.0%	0.0%	3.6%	18.6%	11.1%
It'll get better and not worse	0.0%	0.0%	0.0%	3.6%	7.4%	7.4%

Table 6. When will global warming be a serious problem?

Here, we note that the participants offer different time schemes for serious consequences of global warming. Most of them situate the seriousness of the problem in an interval of between 11 and 99 years without, however, being too affirmative in their answers. Some believe the phenomenon to already be serious while others admit they rather like the warmer weather.

In conclusion, many adults, some teenagers, but no children, had noticed signs of climate change in their milieu. The signs are noticed more in the semi-rural milieu. Most participants believe the problem will affect them in their old age or will have consequences on the lives of their children.

Feelings about the phenomenon

Table 7 groups participants' answers to the question, "Do you sometimes think about climate change? If yes, what do you think?" These answers show a weak preoccupation with climate change. Few participants admitted to worrying or thinking about the problem.

Thoughts	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't think about it	87.4%	91.5%	78.5%	64.3%	55.5%	48.1%
Yes, I'm worried	4.2%	0.0%	10.7%	28.6%	22.2%	29.6%
Yes, after extreme events	4.2%	4.2%	3.5%	7.1%	22.2%	3.7%
Yes, I ask myself questions about it	4.2%	0.0%	0.0%	0.0%	0.0%	7.4%
Yes, I like this climate	0.0%	4.2%	0.0%	0.0%	0.0%	11.4%

Table 7. Thoughts dedicated to climate change.

Table 8 explains the participants' lack of preoccupation with climate change. We first note that a sizeable number of teenagers and adults feel that climate change will probably have no impact on their lives. The reasons given are interesting: "No, not here! Not in the city, more in the country!" or "No, not in Canada! The government takes care of pollution!" A small number of participants are however able to predict plausible consequences: changes in water and food supply, modifications in clothing, heating and climate control habits, etc.

Consequences	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	95.7%	100.0%	7.1%	25.0%	25.9%	0.0%
No consequences in my own life	0.0%	0.0%	75.0%	32.1%	40.7%	48.1%
Changes in my pastimes	0.0%	0.0%	17.9%	14.3%	7.4%	29.6%
Spread of disease	0.0%	0.0%	7.1%	7.1%	7.4%	0.0%
Extreme events could kill me	0.0%	0.0%	0.0%	10.7%	0.0%	7.4%
Going outside less	4.2%	0.0%	0.0%	10.7%	0.0%	0.0%
Differences in heating and climate control	0.0%	0.0%	0.0%	0.0%	3.7%	11.1%
Clothing changes	0.0%	0.0%	3.6%	0.0%	0.0%	7.4%
Water supply problems	0.0%	0.0%	3.6%	0.0%	3.7%	3.7%
Food supply problems	0.0%	0.0%	0.0%	0.0%	7.4%	3.7%
Changes in modes of transportation	0.0%	0.0%	0.0%	0.0%	0.0%	3.7%

Table 8. The consequences of climate change in my own life.

Table 9 also offers explanations for participants' lack of preoccupation with climate change through questions about the possible positive aspects of climate change. We note here a great variety in the answers given. Some feel warmer temperatures provide an important benefit: "It's more comfortable!" "Less shopping for clothes," "To the beach more often!" However, other participants hesitate. They appreciate these warmer temperatures, but

are worried about the imbalance it represents: “We don’t know what could happen!” “We can’t predict the weather anymore!” “Here, we were made to have cold winters! “It’s better when in the middle!” Finally, others adopt the firm position that the situation is truly disquieting.

Answers	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	87.4%	79.0%	10.7%	35.7%	14.8%	3.7%
It's better now	8.3%	16.6%	28.6%	46.4%	22.2%	25.9%
No, it's really bad	4.2%	4.2%	60.7%	17.9%	40.7%	14.8%
I like it now, but it's not good in the long term	0.0%	0.0%	0.0%	0.0%	22.2%	55.5%

Table 9. Possible positive aspects of climate change.

In brief, the general feeling people have about climate change is that the phenomenon elicits little worry. The belief that the problem will likely have no consequences in their lifetimes can explain the participants’ lack of worry. This is why some can appreciate warmer temperatures while others are on their guard because they detect an imbalance resulting from that warming.

Actions to slow down the phenomenon

Table 10 informs us about the participants’ knowledge of possible actions and their belief that the population can be mobilized to remedy the problem.

Actions	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	62.4%	74.9%	14.3%	28.6%	18.5%	0.0%
Humanity can not change weather	29.1%	25.0%	10.7%	46.4%	7.4%	29.6%
Reduce pollution and recycle	4.2%	0.0%	46.4%	21.4%	25.9%	33.3%
Reduce use of the automobile	0.0%	0.0%	17.9%	7.1%	25.9%	33.0%
Leave the problems to scientists and politicians	4.2%	0.0%	21.4%	0.0%	11.1%	14.8%
Avoid burning garbage	0.0%	0.0%	0.0%	17.9%	0.0%	7.4%
Educate people	0.0%	0.0%	3.6%	0.0%	7.4%	11.1%
Take community action	0.0%	0.0%	14.3%	0.0%	0.0%	0.0%
Reduce the use of aerosols	0.0%	0.0%	3.6%	3.6%	3.7%	0.0%
Plant trees	0.0%	0.0%	3.6%	0.0%	3.7%	3.7%
Adopt a simpler lifestyle	0.0%	0.0%	7.1%	0.0%	0.0%	0.0%

Table 10. Possible actions to slow down climate change.

Here, we notice a widespread idea among children and teenagers, and still present in adults: the climate cannot be modified because nature decides, not humans. We can also observe in some people an image of pollution-waste that must be stopped through recycling. Finally, we can see that several participants are not sure they are competent or important enough to make a difference: “We have to leave the problem to the scientists.” “Me, I can’t do anything!” A small portion of participants knows of the link between certain actions and global warming.

The last question asked of the participants dealt with their impressions of the general population’s ability to really modify its behaviour (Table 11).

Answers	Children (n=24)		Teenagers (n=28)		Adults (n=27)	
	Montreal	Moncton	Montreal	Moncton	Montreal	Moncton
I don't know	100.0%	100.0%	7.1%	21.4%	14.8%	0.0%
No, people don't feel concerned	0.0%	0.0%	82.1%	57.1%	33.3%	25.9%
Yes, thanks to laws and education	0.0%	0.0%	7.1%	7.1%	40.7%	40.7%
No, people cannot change the weather	0.0%	0.0%	3.6%	7.1%	0.0%	22.2%
Yes, when it'll be serious	0.0%	0.0%	0.0%	7.1%	11.1%	11.1%

Table 11. Possibility that people can change their behaviour.

In Table 11, we can see that adults are, in general, more confident than teenagers about the possibility of a massive action favouring the slowing of climate change. Teenagers affirm: “Adults are too busy . . . too materialistic . . . too individualistic . . .” The adults, however, explain: “If we educate them, they can change. They’ve already done it with sunscreen . . . seatbelts . . . recycling . . .”

Synthesis of the results

In general, the climate change phenomenon is not well known to 8 or 9 year-old children, a little better known to 13 to 14 year-old teens, and more familiar to adults, without however saying that those same adults understand fully the causes and consequences of the environmental problem. Similarly, participants’ ideas do not differ depending on their location, either a big or small city.

The following list sums up the main ideas (including some misconceptions) provided by participants that have heard of climate change:

- climate change is indicated by a general increase in temperature (10% of children, 44% of teenagers, 55% of adults),
- temperature has become fickle and unpredictable (10% of children, 16% of teenagers, 14% of adults),
- the hole in the ozone layer is responsible for the problem (12% of teenagers, 29% of adults),
- the greenhouse effect is a hole in the ozone layer (7% of teenagers, 22% of adults),
- the overproduction of CO₂ causes climate change (24% of adults),
- the greenhouse effect is a layer of dust under which heat gets trapped (10% of teenagers, 11% of adults),
- I have noticed signs of climate change where I live (8% of children, 32% of teenagers, 72% of adults),
- global warming will occur during my lifetime or that of my children (39% of teenagers, 64% of adults),
- I don't really think about the phenomenon (71% of teenagers, 51% of adults),
- the phenomenon worries me (19% of teenagers, 25% of adults),
- the phenomenon will not have consequences on my life (53% of teenagers, 44% of adults),
- the phenomenon could have consequences on the way I feed, clothe, entertain myself, etc. (28% of teenagers, 42% of adults),
- I prefer this warmer temperature (12% of children, 37% of teenagers, 24% of adults),
- today's climate is bad (39% of teenagers, 29% of adults),
- the weather is nice, but the situation hides an imbalance (38% of adults),
- humanity does not have the ability to influence the climate (27% of children, 28% of teenagers, 18% of adults),
- I cannot take care of the problem, it must be left to more important people (10% of teenagers, 13% of adults),
- recycling and a decrease in pollution could improve the situation (33% of teenagers, 29% of adults),
- decrease in the use of the automobile could improve the situation (25% of teenagers, 14% of adults),
- the population will agree to modify its behaviour (40% of adults), and
- the population will not agree to modify its behaviour (69% of teenagers, 29% of adults).

The study conducted in Montreal and Moncton favours a more judicious choice of educational strategies to teach the population about climate change. Following those results, the general approach we suggest consists of bioregional awareness of the phenomenon, awareness that can be attained through various educational strategies. One of these is the “critical socio-constructivism.” In fact, people are interested in discussing the problem and giving their opinions. They are also competent in noticing signs of changes in their milieu as well as in predicting their consequences. Climate change education could be presented as a generalized discussion, involving youth, adults, and scientists on the question: “Does global warming exist or not?” Learners would be invited to formulate their initial idea, watch for signs of change, and emission sources in their milieu, share those observations with their peers (or with scientists), and reconstruct their ideas if need be. This socio-constructivist method ensures awareness, elicits interest, and favours the evolution of concepts without forcing learners to espouse the teachers’ or scientists’ beliefs.

Our second choice is “future education” (Hicks, 1996; Ziegler, 1991) and consists of inviting people to leave their daily lives behind in order to reflect on their future. They visualize the elements that will make up their life and the effects of these new elements. Future education exerts a role of empowerment: learners realize they hold the power to modify the future. Following observation of local signs and emission sources, learners could be invited to predict what could happen when these signs and emissions become more abundant: What will happen to your area? Who will be affected? How? This way, learners could evaluate their community’s sustainability and its resistance to extreme events: freezing rain, flooding, cyclones, high tides, tropical virus infection, etc. That sustainability could be investigated on the following levels:

- Health: “Are your fellow citizens in good enough health to survive? What could happen?”
- Ecological: “How will animals and plants react? Are they healthy enough to survive? What species could dwindle or disappear?”
- Economic: “How will extreme events affect natural resources that favour economic wealth?”
- Social: “Is your community sufficiently cohesive (united) to face extreme events?”
- Chemical: “What is the pollution level of the water in your milieu? If marine organisms are already sick, how would they react to a storm?”

- Urban: “What will happen if the sea level goes up by 0.50m? What infrastructures and citizens will be affected?”

This method encourages observation within the local milieu and checking its capacity to compose future scenarios. Actions can trickle down from these observations.

Another promising education strategy is “image education.” Hyerle (1996) suggests that this strategy could profitably be used to teach scientific subject matter. In the case of climate change, learners would first be invited to draw their initial conception of elements like gaseous pollution, the greenhouse effect, methane, CO₂, and the thinning ozone layer. Subsequently, clearer images of these diverse elements would be proposed to the learners. Similarly, the presence of an imbalance in contemporary temperatures could be underscored through such use of imagery, since many participants were preoccupied by the problem and claimed to be worried about such an imbalance.

Another educational strategy could be recommended for more in-depth educational work focusing on developing knowledge and appreciation of regional fauna and flora, and various seasonal weather patterns. The idea of going outside and perceiving ambient elements creates a link with these elements. A reflection exercise could follow this direct contact: Do we really want to lose the piping plover, the boreal clintonia, snow, the return of spring, and so on?”

This study allowed us to obtain information on the barriers that could block the adoption of more favourable behaviour: the lack of knowledge and understanding of the phenomenon, the idea that humanity cannot modify the climate, the lack of trust in the possibility of mobilizing the population, and the estimation that climate change will not have consequences on one’s own life (in town). To counter these barriers, the theory of reasoned action (Fishbein & Manfredo, 1992) could be profitably used. According to Fishbein and Manfredo, human beings decide to adopt a new behaviour based on two determinants: their personal attitudes toward that behaviour and their perception of social pressure exerted to encourage that behaviour. Behaviour could thus be the object of frequent and explicative publicity. The media could present individuals who have modified their behaviour as they explain why the new behaviour is important in their milieu and how they’ve integrated that behaviour into their daily lives. On the community level, measures taken by communities or social groups to reduce their impact or become more sustainable could be highlighted. A link between climate change and community sustainability (on the social, ecological, economic, and health levels)¹ has been clearly established.

Conclusion

The present research allowed for identifying ideas that children, teenagers, and adults have built about climate change. This still largely unknown, or insufficiently understood, phenomenon does not preoccupy the population. Opinions are divided when it comes to the causes and consequences of climate change, and the possible mobilization of the population. Various educational interventions have been suggested to improve the level of climatic literacy: the socio-constructivist method, future education, image education, appreciation of the natural milieu, and the use of exemplar individuals' and communities' actions. These strategies, that situate and explain the phenomenon at the local level to then allow discussion at the global level, should be examined further.

A research project² is currently underway in three coastal communities of Eastern Canada: Barachois, Cap-Pelé, and Grande-Digue. The proposed pedagogical interventions in this article are being tested in three grade seven adolescent classes. During their geography and science classes the students become researchers and question themselves on the presence, causes, and consequences of climate change in their milieu. Divided into groups of meteorologists, ecologists, town planners, chemists, and doctors, they study the state of their community and the possible repercussions of climate change. The students communicate with each other and with specialists to exchange information through an electronic message board for this purpose (www.umoncton.ca/littoral-vie/Jeunes-visionnaires/modifier.htm). They will also participate in a scientific conference to share their research findings. The students will then choose and carry out actions to reduce emissions and prevent the effects of sea level rise.

The results of the present research project were also used to validate and adjust the design of the educational programs "Climate Warming" and "The Moods of the Weather" at the Biosphere Museum in Montreal.

Notes

¹ A durable community on the social level is more cohesive. Its members support each other and help each other out, making them more apt to collaborate during extreme events. In a durable community at the ecological level, organisms and their ecosystems are healthier. These organisms and ecosystems would be more resistant to face unforeseen changes in weather. A community with a varied economy will also suffer less from the consequences of climate change, the disappearance of certain resources, for

example. The members of a healthy community will be more resistant to tropical viruses and more solid when facing extreme events (for example, heat waves).

² This project received funding from Climate Change Action Fund, Government of Canada.

Notes on Contributors

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Linda Liboiron developed the Environmental Education Strategy of the Biosphere whose mission is to encourage people to take action to protect the Great Lakes and the Saint-Lawrence River Ecosystems. She supervised the development of "Climate Warming" offered to the museum clientele and "The Moods of the Weather," a program for schools.

Émilie Vrain worked for the Visitors Services of the Biosphere. Because of her training in tourism at Lasalle College and her combination of analytic and dynamic personality, she was recruited to interview teenagers in Montreal.

Hélène Gravel is a professor at the Université de Moncton working in the Masters's of Counselling program. She does research in vocational counselling, phenomenological and relational experiences.

Wendy Bourque has a BSc in geology and is currently coordinating a project on education about climate change in three coastal communities. She has also been a research assistant in the « Littoral et vie » project (www.umoncton.ca/littoral-vie) which focused on educating a community about their local environment.

Joanne Langis completed a BSc (biology and biochemistry) and a Master's degree in Environmental studies. She is currently working as a research assistant at the Université de Moncton on a project to educate grade 7 students about climate change.

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