

Article

## Swedish Upper Secondary School Students' Conceptions of Negative Environmental Impact and Pricing

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**Abstract:** This study explores relationships between upper secondary school students' understanding of prices and environmental impacts. The study uses responses from 110 students to problems in which they were asked to explain differences in prices and also to express and justify opinions on what should be the difference in prices. Very few students expressed an environmental dimension in their understanding of price. A few students suggested that environmental impact influenced price by raising demand for "Environmentally friendly products". A few students suggested that 'environmentally friendly products' had higher prices because they were more costly to produce. We found no examples of students combining both lines of explanation. However, nearly half of the students believed that prices should reflect environmental effects, and this reasoning was divided between cases where the point was justified by a broad environmental motivation and cases where the point was justified in relation to incentives—to get consumers to act in a more environmentally friendly way.

**Keywords:** externalities; conceptions of price; conceptions of human and physical environment interactions

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## 1. Introduction

Several studies have investigated students' understanding of climate change. Students believe that global warming and climate change are broadly influenced by human activities [1], yet research on the understanding of the causes of global warming has observed conceptions that are located exclusively in the physical domain: 'climate change is related to the ozone hole' [2], "the earth getting closer to the sun" [3], "increase in solar radiation" [4] or "pollution is preventing heat from going into space" [5]. This may reflect the interests of researchers, since studies of learning about environmental issues have predominantly focused on natural scientific understanding [6,7]. This research addresses the gap in our knowledge of how students conceptualize the relationships between the economic dimension of human activity and negative environmental impact, such as climate change. This places the research within a set of studies that have examined conceptions of relationships between human and physical effects on the environment. Previous studies [8,9] found that students' conceptions in this field can be broadly classified as either regarding environments as objects to be used by humans to serve their interests or as treating environments as having intrinsic value, which should be respected in the conduct of interactions between humans and environments.

In this study, we follow four theoretical principles. The first is that conceptions of any particular phenomenon can be divided into a small number of qualitatively distinct ways of understanding that phenomenon. This principle is widely followed in conceptual change [10] and social psychology [11] research. Global reliance on markets to address resource issues places conceptions of price at the center of the environmental stage. Previous research on conceptions of price has avoided examples that highlight environmental concerns. In this study, we investigate students' conceptions of the prices of products and services that have widely reported environmental impacts. The second principle we follow is that the conceptions that individuals reveal will commonly vary by context: a student may express conception of price (A) when asked about situation (X) and conception of price (B) in situation (Y). This is consistent with the phenomenography [12] and alternative framework [13] traditions. The third principle is that naive conceptions (which develop through shared common sense interpretations of experience) may be interpreted either as "knowledge in pieces" or as dependent on an "alternative framework". For example, previous research [14] has identified one naive conception of price as an intrinsic quality of a good or service. This may be read either as an isolated fragment within a student's thinking or as a reflection of a taken for granted relationship between the student and retailers. Finally, we take the view that it is appropriate when investigating conceptions in social science to follow a line of analysis that is not used in the research on conceptions in science. That is, it makes sense [15] to ask students questions, such as "What *should* be the price of X?", as well as "Why *is* this the price of X?" This distinction has particular importance in the context of environmental education, since it is motivated partly by an aim to equip young people with a capacity to shape future policy and practice, which will affect future environments.

The study uses data collected from Swedish students aged 16–18 who have chosen to take additional courses in business and economics in school. Data were collected through problems, which asked students about the prices of products that are associated with environmental impacts and climate change. Upper secondary school students are already experienced as independent consumers, and they are approaching the age at which they can vote in democratic elections. The way in which they

exercise their roles as citizens and consumers is a matter of collective concern, since their decisions will shape the way in which markets and politicians behave. In this context, we focus on students' understanding of the role of market mechanisms relevant to their personal experience. It is important to note that market analysis expects the value of resources used up in production to be reflected in the product price. However, some costs of production (known as externalities) [16] are not borne by producers and are not reflected in market prices. These negative externalities occur when producers do not have to pay for resources they consume or, for example, when by-products of production damage environments at no cost to the producer. Therefore, the notion of a negative externality is critical to conceptions of climate change and other environmental issues. This leads us to ask: how do students conceptualize negative environmental effects when reasoning about prices of various items?

Policies towards environmental issues (such as climate change) are framed by the beliefs of voters and consumers about the extent to which market mechanisms provide efficient and fair solutions to the use of resources. Therefore, we also investigate the beliefs of young people about appropriate prices for products known to be associated with substantial negative externalities. We investigated these beliefs through a second research question: do students believe that negative environmental effects should be reflected in prices of goods that generate negative environmental impacts and, if so, how do they reflect those? Whilst there is substantial literature on students' conceptions of price [10–12], this research has largely ignored the way in which students relate prices to environmental impact. This may be partly because the products used in these studies (e.g., a bun, a toy and housing) are not obviously associated in the public mind with environmental impacts.

The evidence available on students' environmental beliefs from the OECDs Programme for International Student Assessment—the PISA survey [17] and a consumer survey carried out in Sweden do not provide us with answers to these questions. However, the PISA evidence suggests that secondary school students in Sweden have lower levels of environmental concern than their peers in a majority of other countries included in the PISA sample. A survey carried out by the Swedish Consumer Agency [18] indicates that young people's consumer decisions are influenced primarily by fashion and marketing. It appears, then, that there is a case to be made for including a focus on relationships between prices and the environment within the school curriculum. In the Swedish upper secondary school system there was at the time of the study a national syllabus for each school subject. Each of these includes overall goals and objectives, learning goals and evaluation criteria. During the three-year program on social science and business, the students study about sixteen various subjects. Issues on climate change and global warming are explicitly focused on in the learning goals in geography. The compulsory courses in civics and science have a few writings clearly describing learning goals that aim to develop students' knowledge; on ethical and environmental issues important to society, how economics have an impact influencing on societies and knowledge of lifestyles impact on environmental and ecological sustainable development. In the business and economics subject, the links to sustainability are, on the other hand, less clear. In the subjects' second course, one learning goal states that students have to be able to reason on ethical issues and consequences of business decisions for the environment. Focus is on students' learning of conditions and concepts of purchase and selling and how to perform calculates and analysis of profitability. In sum, there are only specific learning goals on climate change in the geography course. Civics and science include a general sustainability perspective already in the first level, while the business and economics subject highlight

this in the advanced level, but there is no specific learning on climate change and economics [19]. The tradition in Swedish environmental education is characterized by a fact-based tradition focusing transference of scientific knowledge and a normative tradition; teaching environmental attitudes and values. A later tradition takes a pluralistic approach to the variety of opinions and integrating the perspectives of economic, social and environmental knowledge in education for sustainability [20]. However, this approach is not so well defined in the curriculum for business and economics.

The next section of the paper summarizes previous research on young peoples' economic and environmental understanding. This is followed by a description and explanation of the design of the study. The explanation includes a summary of negative environmental impacts of production products included in the study. The final section presents evidence of students' reasoning and discusses the significance of this evidence for teaching and learning.

### *1.1. Young Peoples' Economic and Environmental Understanding*

Social psychologists have investigated students' understanding of the economy to build a picture of "economic socialization", and more than 35 studies have focused on children's understanding of this topic [21]. Concepts, such as money and value, work, wealth and poverty, profit, buying and selling have been important areas of study, while price and inflation have been given particular attention [22]. A second program of research has been conducted in the phenomenographic tradition, and researchers in this field [12,14] have investigated conceptions of the price of a wide range of products. Both research programs have concluded that conceptions of price may be categorized as reflecting (i) the intrinsic value of a product, (ii) demand for the product, (iii) supply of a product or (iv) demand and supply of a product. None of the studies has investigated understanding of price in relation to externalities, and this is reflected in the categories of conceptions that have been suggested. However, students' conceptions of price can also be distinguished according to whether they treat price as an individual relationship between a buyer and seller or as a market relationship between many buyers and sellers. This distinction may be important for environmental education insofar as prices act as incentives to discourage "over-consumption".

One recent study [15] has investigated students' conceptions of externalities in the context of students' conceptions of whether goods and services should be made available for free. This study shows that individual experience influences conceptions of whether something should be made available for free. For instance, many students took it for granted that sitting on a beach and driving a car on a road should be free. Their experience had led them to consider this as normal. The study also reports evidence of conceptions that incorporate *consumption* externalities. A minority of students argued that individuals should have to bear any personal health costs that arise from over-consumption of food, such as beef burgers. This cost becomes an externality when it is borne by others through a national health system. Students' reasoning in both these cases draws on a belief that there will be 'over-consumption' when prices do not reflect costs in full.

Some additional insights into students' understanding of and attitudes towards environmental impacts of their consumption are suggested in a national consumer survey and the international PISA study. The Swedish Consumer Agency [18] conducted computer assisted telephone interviews with 1,010 15–17 year-olds. They found that the main influences on young people's purchase decisions

were the price and quality of goods, followed in importance by fashion and brand labels. A minority of the students sometimes considered consequences of their purchases for the natural environment. Only about 10% of respondents *always* or *often* thought of consequences for the natural environment before deciding on their purchases. The PISA survey [17] included questions on young peoples' science knowledge and skills, as well as attitudes towards science. About 400,000 students from 57 countries in the age of 15 participated and 4,600 individuals from Sweden took part in the study. Compared to their peers in other countries, Swedish students have a relative strength in being able to explain phenomena from a scientific perspective, but they are relatively weak in identifying scientific issues and in using scientific facts and arguments. The study also assessed students' knowledge of and attitudes towards clearing forests for other land use, acid rain, the increase of greenhouse gases in the atmosphere, nuclear waste and the use of genetically modified organisms. Compared with average scores across OECD countries, Swedish students displayed slightly better knowledge, but less environmental concern.

In summary, although young peoples' environmental knowledge and attitudes and economic understanding of pricing have been extensively researched, we know little of students' thinking about relationships between market forces and environmental issues. This study addresses this gap in knowledge.

## 2. Method

### 2.1. Data Collection and Analysis

The data was collected through problems posed to 110 students from six classes in two municipally governed upper secondary schools in the Stockholm region, Sweden. All students had chosen to take additional courses in Business or Economics. The problems were administered within normal lesson time. Students received a briefing on the purpose of the study and were given an opportunity to leave the lesson. Students were asked to consider the prices of different products. They were asked to explain what determined the price of the products, and they were also asked whether they thought the price should be different from its current level and, if so, why there should be this price difference. All students were asked to provide detailed written answers.

Every student was asked about the price of travel, and students in each class were also asked about the price of one other good or service. These additional products or services were taken from a list that comprised everyday bought goods, such as beef burgers, cotton socks and bottled water, and more infrequently bought goods, like travel services, jeans and personal computers. These products were chosen on the basis of the available evidence of negative environmental impact from production or consumption. The goods were also selected on the basis that they were familiar to students so that they could draw on their own experiences as consumers [18]. The problems posed to students are presented in Table 1. It presents an overview of what questions the students elaborated on in the open-ended questionnaire.

**Table 1.** Problems presented to students.

<b>Group/ students</b>	<b>Compared pair of goods</b>	<b>Students ages and course</b>
Group A–F 110 students	A friend invites you to London and, you discover that there is a price difference on various <i>tickets</i> to London. How would you explain that a return ticket with airplane costs 308 SEK and a train ticket costs 2,495 SEK?  Should the flight ticket cost more than the train ticket? Circle your answer.    Yes    No    Do not know Please, describe your thoughts on how you motivate this.	
Group A 18 students	You are downtown with some friends, when you decide to eat a beef burger. You compare the price for a "cheeseburger" between two burger restaurants. In one restaurant, the burger costs 13 SEK, and in another, it costs 15 SEK. How would you explain this?	Mixed ages 16–18, taking a Business Basic Level.
Group B 23 students	You can drink tap <i>water</i> in your kitchen for about 0.025 SEK/ liter. In the local grocery store, one liter of non-carbonated water costs about 20 SEK. How would you explain this?	16 years old, taking a Business Basic Level.
Group C 20 students	You are planning on buying new <i>cotton socks</i> and you go to the shop. When you have decided on a pair of socks, you discover that the price on these particular socks is higher than the other cotton socks in the shop. How would you explain this?	17 years old, taking a Business Basic Level.
Group D 12 students	You are planning on buying a new <i>personal computer</i> . When you have decided on the computer, you discover that the price is higher than for the other PCs in the shop, despite them being equal in size and contents (effects). How would you explain this?	17 years old, taking a Business Basic Level.
Group E 31 students	You plan to buy a new <i>pair of jeans</i> and enter a shop you like. After you have decided which pair to buy, you discover they are higher in price compared to the other pairs in the shop. How would you explain this?	16 years old, taking a Business Basic Level.
Group F 6 students	The same problem as group B (drinking water).	16 years old, had not started Business Basic Level yet.

Interpretations of written utterances need to consider students' concern with writing correct answers. For that reason, the students were told the questionnaire was not a test and would not be shown to the teacher or anyone else in the school. A content analysis [23] approach was used, and all

written responses were read and reviewed carefully several times by the first author to identify the units of analysis, that is, each individual's reference(s) to the use of resources of natural environments in relation to prices for each of the goods in the sample. This preparation phase resulted in two groups of data, with one group of students that did not highlight any environmental connection and one small group with students explicitly doing this. In the next stage, these individual phrases were transcribed into Swedish and coded in terms of what themes on environmental content individuals identified in relation to the prices. The themes were transcribed into English and deductively categorized after a categorization matrix, based on earlier research findings, of price generating factors: (i) the intrinsic worth of a product; (ii) demand for the product; (iii) supply of a product; or (iv) demand and supply of a product. This analysis was discussed with the second and third author at various situations. A few different interpretations of students' utterances resulted in further discussion. A few disagreements arose on how to distinguish short and less elaborated utterances between category (i) and (iii). This was solved by recognizing the utterances in category (i). A fifth category was developed from a couple of individuals utterances that did not include references to pricing, but to environmental thinking in general. This was statements, such as "I think I would choose the environmentally friendly good", given on the question of how pricing was arranged for various goods. The analysis process also included transcribing and coding the phrases students used as arguments when suggesting increased prices for a particular travel service. In the preparation phase, the first author read and identified students that made positive stands to the question: should a flight ticket cost more than the train ticket? Each utterance was transcribed and categorized according to how environmental impact was referred to. In the next stage, the transcriptions and categories were discussed and agreed on among the authors. Graneheim and Lundman [24] emphasize the value of dialogue among co-researchers, both in verifying that data are sorted in the same way and to agree on the way data was sorted out. This was a process guiding our work during the analysis. Parallel to this, the analyses were presented and discussed at recurrent occasions in a regular research seminar with a handful of researchers engaged within the conceptual change field.

## *2.2. Price, Externalities and Greenhouse Gas Emissions for the Selected Goods and Services in This Study*

A socially efficient price should reflect all the costs of the goods' production. This includes the value of physical resources used up in production and any spillover effects (such as pollution) that arise during the production process. In principle, a socially efficient current price should take account of future demand, sustainability and spillovers, including the effects of production on climate change. When resource use or spillovers are not reflected in the market price, the value of resources used or the impact of the spillover in terms of the loss in value of damaged resources is referred to as a negative externality. So an "environmental impact" (in terms of depletion of a scarce mineral or reduction in river quality through chemical discharges) may be captured in the market price or may give rise to a negative externality. In this case, consumers do not fully compensate others for the resources that have been used up or degraded in the production and provision of the good or service [16,25,26]. In addition, we would normally expect that when there are negative externalities, the level of production is too high, since the market price will be below the socially efficient price and, therefore,

demand will be too high. Greenhouse gas (GHG) emissions are frequently cited (e.g., Stern) [27] as important examples of this kind of market failure. According to the UNEP Finance Initiative [28], the environmental costs from solely global GHG emissions will rise from about 7% in the year 2008 to 13% of the world's GDP in the year 2050. When, including other sources of environmental impact, such as pollution, the projected external cost relative to global GDP rises to around 18%. This is a very rough estimate, since one has to take into account the lack of comprehensive global data.

We now briefly outline some evidence of environmental impact from the production of six goods (travel, beef burgers, water, cotton socks, jeans and personal computers), which provide the focus for our investigation of students' thinking. Insofar as the production and distribution of each of these products entails transport costs, they each contribute to GHG emissions. Within the EU [29], the transport sector is the second largest GHG producer, after the energy sector, and more than 60% of those emissions are related to road transport. In contrast to other sectors of the economy, total emissions from transport increased between 1990 and 2007. The GHG impact from meat production has been estimated in several reports. For example, the food and agricultural organization of the UN [30] estimate that about 18% of global anthropogenic GHG emissions can be attributed to animal production alone. The most effective production processes generate about 14 kg of CO<sub>2</sub> emissions for every one-kilo of beef. The measured effect of farming on GHG is much higher when we take deforestation and secondary energy consumption (e.g., through diesel, electricity and oil use in farms and silage production) into account [31,32]. The production of bottled water has environmental implications through the use of energy for manufacturing, processing and transporting the bottles. The energy cost for the production of the bottled water has been estimated to be 2,000 times the energy cost of producing tap water. The use of bottled water rises compared to the per capita consumption of carbonated soft drinks and adds to the relevance of this product for our study [33,34]. This is also a trend in Sweden, and according to the Swedish Brewery Industry, the annual individual consumption of bottled water has increased from about 10 liters in 1992 to 22 liters in 2010 [35]. The manufacture of cotton socks and jeans generates various production externalities. Cotton fabrication uses huge quantities of pesticides, and the use of petroleum in the production of pesticides generates emissions of CO<sub>2</sub>. In addition, the emissions of nitrous oxide (N<sub>2</sub>O) from the production process have a greenhouse gas effect, estimated to be 310-times greater than that of CO<sub>2</sub> [36,37]. Our final example of an item with environmental contamination associated with production and consumption is a computer. It consists of several metals and chemicals that can pose a risk to both ecosystems and human health when disposed or recycled [38].

### 3. Conceptions of Negative Environmental Impact in Goods Pricing

Only a small group of fourteen students (13% of the sample) included any reference to negative environmental impact in their reasoning about prices. We regard this as an important finding from the research. In this section, we concentrate on the thinking of these fourteen students. We present our findings by first describing how they reason about the relationship between prices and the environment. In the second part, we describe students' views on how environmental impacts *should* be reflected in prices. Roughly two-fifths of our sample made some reference to negative impact when describing their preferences.



### 3.1. Conceptions of Negative Environmental Impact Influencing Prices for Single Items

None of the students suggested any environmental effects associated with the price of jeans. Students referred to environmental impact in their account of prices of beef burgers (22%) and cotton socks (15%) more frequently than in their accounts of prices of personal computers (8%), drinking water (7%) and travel services (5%). The students suggested that these products had higher prices when they were produced by “environmentally friendly” processes (e.g., a process causing lower greenhouse gas emission). The following quotations illustrate ideas of pricing in relation to beef burgers, cotton socks, travel services and drinking water.

Eric: *...the train is more comfortable and environmentally friendly and this it is more expensive than the flight.*

Carin: *They (the cotton socks) are perhaps ecological or a more expensive quality.*

Andreas: *The other hamburger business chain has perhaps more expensive ingredients or ecologically produced goods and therefore their burgers get more expensive.*

Camilla: *Because the more expensive ones (socks) are perhaps produced by finer material or perhaps they are produced in a more environmentally friendly way that can cause higher prices.*

Amy: *It can depend on various things. One restaurant choses to invest in better raw material, perhaps more ecological goods for the customer's sake. The transportation cost, for the food arriving to one of the restaurants, cost perhaps more. One of the restaurants has perhaps a higher quality in the food.*

Blanka: *It is not the water itself that has the price of 2 Euro, it is the bottle. It is often produced from plastic, which generates emissions and a lot of people do not care to recycle. The transportations also contaminate and that makes it more expensive.*

In these examples, the students suggest two connections between prices and negative environmental impact. Eric and Carin state that the characteristic of being “an ecological good” is an attribute of a more expensive good. There is no indication in their utterances of any market process. Andreas and Camilla argue that the prices are higher because more expensive, environmentally friendly ingredients have been used in the production process. In the categories of “conceptions of price”, which have been developed in previous research, this is a conception of price in terms of (cost of) supply. The implicit reasoning in these statements is that supply prices internalize emissions and other environmental effects in addition to direct costs of resources used in production. Blanka’s statement makes this point more explicitly. Ten of the fourteen instances where students included a reference to environmental effects in their explanation of price fell into one of these two categories: “environmentally friendly as an intrinsic quality of a more expensive good” or “environmentally friendly products are more expensive to produce”. In the next two examples, we observe students arguing that some customers are willing to pay higher prices for products they believe are more environmentally friendly. In this argument, the cost of environmental degradation is internalized through the consumer’s demand rather than through the cost of supply to the producer.

Daniel: *The difference in prices (for computers) might depend on brand and relevance. Often things cost more when they use less electricity. This influences how the customer considers the environment and electricity costs.*

Emma: *A train takes longer time and it is much more environmentally friendly than the flight. Therefore some people can pay much more to get to travel environmentally friendly.*

Blanka, who gave a more explicit statement of the argument that some environmental degradation effects may be incorporated in the supply price, also recognized the existence of externalities, which are not reflected in the market process, and the possibility that some consumers will be willing to pay more for eco-friendly products.

Blanka: *Flying is cheaper, but generates too much pollution. Earlier the flight also cost about 283.40 Euro, but has become less expensive while more people chose travelling by train, which is more environmentally friendly.*

This student was alone in our sample in suggesting environmental issues in relation to both products (travel and bottled water) she was considering. She was also the only student who clearly expressed a conception of price as a market, rather than individual, phenomenon. This small group of students presenting ideas on environmental impact in relation to prices focused mainly on production supply costs. There was only one explicit reference to negative externalities and only a couple of references to consumer demand being higher for environmentally friendly goods.

### 3.2. Students' Conceptions of How Travel Services Should Be Priced

We now turn to students' beliefs about the prices that should be charged for travel by plane and train. We have responses to this problem from each of the 110 students. Just under 40% of students included some reference to negative environmental impact in their arguments about price setting. They stated: the price should be higher for plane journeys because of greater environmental impact. The most basic statements of this argument simply stated that plane prices should be higher because of greater emissions.

Anna: *Because it causes more harm to the environment if one flies...*

Bella: *Flights are more comfortable, one arrives faster and the environment is more harmed.*

Bror: *Because flights increase the environment with CO<sub>2</sub>. The train on the other hand is electrified so there is no harm.*

Ella: *(The flight should cost more) because it has more emissions compared to trains.*

More than half (28/43) of the statements about how environmental impact should be reflected in relative prices fell into this most basic category. However, some students went on to argue that higher prices for plane travel, which internalized externalities, would have the effect of reducing consumer demand and, therefore, emissions:

Amy: (The flight should be more expensive) *probably because of the global greenhouse effect, which is increasing more and more today. People would perhaps choose train, instead of flights, as a far more environmentally friendly alternative.*

Bert: *If the prices for flights increase not that many are willing to go by flight and there is less environmental problem and emissions.*

Camilla: *It is better for the environment if more people chose to travel by train that is why I think one should increase the flights' price so more people chose the train. And also, the flight let out more emissions and one can perhaps donate money to those who work with the environment.*

Roughly one third of the statements (15/43) fell into this category. These statements (especially the statement by Camilla) express a market conception of price. Whilst this is still a minority of students, it contrasts with the one student who expressed this conception when asked about the factors affecting current prices.

#### 4. Discussion

Only a small minority of students referred to environmental factors in their explanations of prices of a range of products associated in academic literature and popular media with environmental degradation. Our results are similar to those reported by the Swedish Consumer Agency [18], which found that about 10% of young consumers, in the age range of 15 to 17, claim to often or always consider ethical or ecological impact from goods they plan to purchase. It is possible that a different format of the written problems or in-depth interviews could have suggested that more students did have some conception of a relationship between price and environmental effects. However, our evidence suggests that environmental effects are not in the foreground of most students' thinking about prices. Most of the students who referred to environmental factors in the context of one product did not refer to environmental factors in their explanation of the price of the other product. Much of the emerging environmental awareness of these students is restricted to a conception that some products are eco-friendly, whilst others are not.

A much larger proportion (just under 40%) of the same group of 110 students referred to environmental impacts when asked to discuss the prices that *should* be charged for travel by plane or train. The 'should' question stimulated the expression of environmental issues, which were neglected in responses to the 'what' question. There may be a question of individual and collective agency to be addressed here if students' beliefs are to be translated into their actions as consumers and citizens. We are not able to tell from our data whether the other students were unaware of differences between environmental impacts of train and plane travel or whether they did not believe any such effects should be internalized in the process.

However, we did find that a few students related environmental effects to market forces, even when they made a connection between environmental effects and price. Eleven of the fourteen students who made statements about environmental effects when explaining relative prices used the most simple conception of price: treating "environmental friendliness" as an intrinsic characteristic of products and production cost, commanding a higher price. Earlier research [12,14] on young peoples' explanations on how price is generated, describes it to be influenced by the intrinsic value of a good, demand for the

good, supply of the good or the relationship between these two mechanisms. This interaction is also presented as something 12-year-olds managed consistently [11] when interviewed about different scenarios in short stories on price change. The students in our sample generally used much less sophisticated thinking about price in relation to environmental issues than has been observed more generally in the literature on conceptions of price. This implies a dislocation in students' thinking about economic (human) factors and physical factors in the context of environmental issues.

Only a third of students who argued that environmental effects should be included in prices went on to suggest that this could reduce demand and, therefore, the extent of environmental degradation. Even in these instances, there was no example of a student arguing that this would lead to a more efficient matching of the benefits and costs of production. Of course, it is likely that a different form of data collection could have revealed that a number of the students had more sophisticated thinking than they chose to display in writing for our study. Nevertheless, the proportion of students indicating any suggestion of this kind of reasoning is so small in our study that it would be surprising if a different form of data collection were to suggest that a majority of students reasoned in this way. Our results are, however, in line with Davies' and Lundholm's [15] results on students' reasoning of what should be for free in the market; showing how students describe an over-consumption, generating negative impact, as an outcome if prices do not reflect costs in full.

## 5. Conclusion

This is a small and exploratory study, but we believe it suggests some implications for teaching, curriculum policy and future research. The results, if they are replicated in other contexts, suggest that teaching of students in upper secondary school faces a substantial task in helping students to think about pricing and environmental issues using conceptions of similar complexity (referring to both supply and demand), which have been observed in other contexts. Our study indicates that students' conceptions on the connection between negative environmental impact and pricing can be characterized, to a large part, on the perceptible aspects of the goods reasoned around and individuals' knowledge or assumptions on what negative environmental impact the goods generate. One can see these understandings as context bound in daily experiences of buying, and we see a great potential for the business and economic subject to include environmental understandings in these contexts.

Our results also indicate a clear distinction between instances where students argue simply that "prices should be higher to reduce environmental effects" and instances where students explicitly argue that when prices reflect negative externalities, this will reduce demand and production, leading to a more efficient outcome. Teachers' awareness of this distinction and their readiness to support students moving from one conception to the other should improve the impact of teaching on students' understanding of environmental issues. Curriculum design often discourages integration between physical science and human (especially economic) perspectives on environmental issues. For example, previous research has largely reported conceptions of climate change that are restricted to the domain of physical science. Students may be encouraged to consider environmental issues in lessons labeled "science", "geography" or "economics", but how does the curriculum support students in making sense of how these perspectives may be connected? This problem is, of course, not restricted to environmental issues. Issues that lie at the intersection of subject domains are at risk of neglect or

duplication or fragmentation. They demand particular attention from curriculum designers, writers of examination questions and curriculum coordinators in schools.

Finally, our study suggests some directions for future research. First, it would be useful to know whether similar results are found with upper secondary school students in other contexts. Second, it would be helpful to know whether curriculum design and teaching can improve students' reasoning about the economic dimension of environmental issues and, if so, how? Third, whilst our study reports on conceptions of the economic dimension of environmental issues, we do not know if such conceptions interact with conceptions of the physical science dimension of environmental issues. There is much yet to be established about conceptions of environmental issues and the extent to which teaching can and does effect conceptual change in this domain.

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### Conflict of Interest

The authors declare no conflict of interest.

### References and Note

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