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(How) should prices be adjusted to reflect the environmental harm of products?

Teacher trainees' understanding of an eco-economic phenomenon

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Zusammenfassung

Das Modell der externen Effekte ist zentraler Bestandteil der Umweltökonomie und wird in einer Reihe von Curricula bzw. Kompetenzmodellen in der ökonomischen Bildung aufgegriffen. In diesem Aufsatz wird untersucht, welche unterschiedlichen Konzepte angehende Lehrkräfte nutzen, wenn sie mit praktischen Problemen konfrontiert werden, die mithilfe des Modells der externen Effekte bewältigt werden können. Um dies zu untersuchen, sind 16 Gruppendiskussionen mit 69 Studierenden der ökonomischen Bildung in Oldenburg und Landau durchgeführt worden. Dabei wurde der phänomenographische Ansatz sowie die dokumentarische Methode zur Datenerhebung und -auswertung genutzt. Es wurden fünf unterschiedliche Konzepte gefunden. Diese werden mit anderen Forschungsergebnissen zu Präkonzepten in der ökonomischen Bildung und dem umweltökonomischen Ansatz verglichen und es werden Vorschläge für die Aus- und Weiterbildung (von Lehrkräften) gemacht.

Abstract

The concept of external effects lies at the heart of environmental economics. Several curricula or educational standards in Germany and the US include the concept as learning objectives in economics courses in schools. This paper researches which conceptions teacher trainees in economics use to deal with real-world problems, which could be handled with the externality concept. Do they use an economic approach or what other solutions might they see as (ecologically) fair? To research these issues, I have conducted 16 group discussions with 69 teacher trainees in two German universities (Oldenburg and Landau). For data collection and analysis, the phenomenographic approach and the documentary method are used. I discover five different conceptions and compare them to other research on preconceptions in economic education and to the environmental economics approach. Based on students´ preconceptions, I suggest and discuss a learning path for teacher training.

1 Introduction[1]

Research on students´ preconceptions in economic education has addressed the price phenomenon in two ways: Dahlgren (1975), Dahlgren/Marton (1978), Pong (1999), Marton/Pong (2005) and Pang et al. (2006) describe variations in students´ understandings regarding the question, why a certain good has a certain price. Davies/Lundholm (2012) have identified different conceptions on the issue, whether a good or a service should be provided for free.

One of the core issues in environmental economics and the focus of this article is the question '(How) should prices be adjusted in case of an environmental externality?' This normative question can be tackled using the externality concept from environmental economics. Several curricula or educational standards include the concept as learning objectives in schools. It is important for teachers to be able to use this concept appropriately, so that they can teach it well. To develop good learning environments for teacher trainees, it is helpful to be aware of their pre-conceptions regarding real-world examples with externalities.

To research students' conceptions regarding externalities, I conducted group discussions with teacher trainees in economics at the universities of Oldenburg and Koblenz-Landau, Germany (Löw Beer 2016).

The remainder of the paper is organised as follows: the next section briefly illustrates the research approach of phenomenography. Here, a particular focus is put on dealing with normative questions. To my knowledge, these have often been implicitly, but never explicitly addressed in phenomenography. I then describe and justify the way in which data were gathered and analysed, referring both to the phenomenographic and documentary method. Section four provides an exemplary answer to one of the scenarios used in the group discussions from an environmental economics perspective. I also argue why market failures and externalities are a threshold concept (Meyer/Land 2003) and describe possible learning challenges. The result section presents five different conceptions used by teacher trainees regarding the question '(How) should prices be changed?' Section six discusses the outcome space, provides frequencies of the occurrence of the different conceptions and describes implications for teacher training using variation theory and other methods from economic education. Section seven concludes.

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2 Phenomenography

Phenomenographic research investigates the qualitatively different ways in which people experience, understand, see or conceptualize a particular phenomenon or an aspect of the world around them (Marton/Pong 2005, 335f.). It aims to create outcome spaces with categories of description. These categories or conceptions represent the different ways of experiencing a phenomenon within a group. They are logically interrelated and in all phenomenographic studies conducted so far, a small and limited number of different conceptions have been discovered.

Phenomenography is rather vague in defining the term phenomena. It refers to them as something experienced as “abstracted from or transcending” (Marton/Booth 1997, 82) a context, a time and/or a place. Phenomenographic research in science education has mainly focused on real world phenomena, i.e. phenomena, which students can physically experience. In contrast, research in economic education typically uses phenomena linked either to a technical concept such as supply and demand as market forces or a competence goal such as rational-decision making under uncertainty (Speer/Seeber 2013).

It would be problematic to use phenomenography for normative questions in general. The whole approach, particularly with regard to its current developments (cf. Marton 2015) is designed to discover those conceptions of students which are relevant for learning a certain content. Phenomenography is not suited to research different opinions per se. However, as Davies/Lundholm (2008) argue, the intertwined connection between normative and positive elements is a specific trait of the social sciences, because of the social construction of reality. As a consequence, it seems reasonable to use phenomenography for normative questions, if they are part of a technical concept or a competence goal. In these cases, it is possible to clearly delineate the technical concept as a learning objective and to use it in order to put the different conceptions of students in a hierarchical order.

The phenomenographic research approach includes a broad vocabulary to describe conceptions. For the following argument, one distinction is particularly important: Analytically, every conception can be described referring to the referential aspect, which denotes the overall meaning of the object conceptualized; and the structural aspect, which shows the specific combination of features that have been discerned and focused on (Marton/Pong 2005).[2]

[2] The theory of phenomenography is described in detail in Marton/Booth (1997). You can find a German summary, which also include a summary of all phenomenographic research in Economic education, in Löw Beer (2016) and Birke/Seeber (2011).

Among the qualitative research methods, phenomenography is unique in combining the use of a second-order perspective (as conceptions are described by a researcher), the focus on variations and internal relations between different conceptions (Trigwell 2000).

The knowledge about different conceptions can be used to design effective lessons. They start with learners' preconceptions and allow them to advance towards a scientifically appropriate way of understanding. Variation theory is used for teaching processes based on phenomenographic inquiries. It includes first varying one critical aspect of a learning object after another (e.g. first variations in demand and then in supply conditions, if the supply-and-demand concept is the learning objective). Secondly, non-defining aspects are varied (e.g. emphasizing the different sizes of objects and its possible connection to their prices). Thirdly, learners experience a joint variation of different critical aspects (Marton et al. 2004, 16f.). Focus is put on the elements that students do not know prior to a learning process. Empirical evidence supports the effectiveness of variation theory for learning processes (Lo et al. 2004; Marton 2015; Marton/Pang 2013).

3 Research design

To study learners´ preconceptions in ecological-economic situations, I have conducted group discussions with teacher trainees in economics. Teacher trainees were chosen as a research group for two reasons. First, as (the internalization of) external effects is a rather advanced concept in economics, it is necessary to first think of ways to make it (more) accessible to teachers before they can then convey it to high school students. Secondly, designing good learning environments for teachers is important as they are prospective multipliers.

I opted for group discussions as method of data collection because they have proven as being useful to study normative questions (Mangold 1960) and as learners confronted with complex questions are often only capable to develop their own ideas while discussing with others (Pollock 1955). It is assumed that one can survey with group discussions ideologies, opinions and attitudes, which are typical for a certain type of groups (e.g. teacher trainees in economics) and which therefore can be reproduced (Lamnek 2005; Bohnsack 2004). A common critique to group discussions is the mutual interference of participants. For two reasons, this is considered unproblematic in the present research: (1) Many learning processes take part in groups. Therefore it makes sense to research groups in order to come up with suggestions, which aim to improve teaching and learning. (2) This research does not aim to reach any conclusions regarding individual conceptions, but focuses on the "collective mind"

(Marton 1981, 196). Also, the smallest unit of people analysed is one focus group. Therefore, I only count the frequencies of conceptions based on a group, not on an individual and do not refer to individuals.

In total, I have led sixteen group discussions with three to six participants with a total of 69 participants. To reach the research objective to discover the broadest possible variety of conceptions within the group of teacher trainees at university level, firstly the study has been conducted in two different German universities: Oldenburg and Landau. In particular, both courses offer one striking difference. In Oldenburg, there is an integrated course of economic education. In contrast, in Landau, students of economic education participate in the regular economics courses for their disciplinary training. Furthermore, there has been variation concerning how advanced students have been: Ten groups have comprised of teacher trainees beginning their bachelor degrees; in five groups teacher trainees have been at the end of their bachelor or at the beginning of their master degrees; one group has been mixed. The group discussions have lasted roughly between one and two hours. Additionally, the sample has included teacher trainees studying economic education for all different school levels.[3]

In each group, two types of scenarios have been used. The first type comprised of a set of four scenarios. Teacher trainees were asked to develop ideas how to regulate an environmentally harmful human activity or to support an environmentally beneficial technology. During the discussions, teacher trainees have been asked to evaluate the ideas brought up by others. The intention of the stimuli was *not* to focus on the question whether ecological aspects should be considered *at all* in personal, entrepreneurial or political decisions, but rather on the questions, which measures should be taken and to which extent.

An example for a stimulus is:

> *As you probably know, environmentally harmful emissions arise out of air traffic. So, I would be curious to know what ideas you have, what one could do to reduce environ-*

[3] The sample has included 25 students studying for Sekundarstufe I/Realschule (lower secondary level, usually leading to a secondary-I-certificate after ten years of schooling), 18 students for Sekundarstufe I and II (lower and upper secondary level), 3 for Grund- und Hauptschule (elementary school and lower secondary level with a total of nine years of schooling), 19 for Förderschule (special school). 4 students have not provided this information.

mentally harmful emissions in air traffic and what you think about the ideas or how you would judge them?[4]

The other stimuli were similar, but dealt with emissions in general and the promotion of organic food as well as solar paint.

In the second type of scenarios, participants were asked to comment on five typical instruments in environmental economics (Engaging the public, direct environmental regulation, taxes/levies, subsidizes, and emission permit schemes). All stimuli are presented in the appendix.

The group discussions have been fully transcribed and analysed using the phenomenographic (Marton 2015, 91) as well as the documentary method (Bohnsack et al. 2013). Both methods have been combined, because the procedure for data analysis in phenomenography is not yet fully developed. I selected the documentary method as it specifically focuses on analysing group discussions. The analysis was based on an iterative process of working through the transcripts. In the beginning, sequences were analyzed by a formulating (very close to the statements, focusing on the immanent meaning) and a reflecting (more interpretation, connections to the ESAV are drawn) interpretation (Bohnsack 2010). In the second step, differences between the units of analysis, i.e. statements by participants, were scrutinized. Thirdly, the material was analyzed for similarities with the goal of a generalization. Finally, logical relations between the units were defined (Marton 2015). Data analysis has been supported by using the qualitative data software MAXQDA 11.

During the data analysis, it became evident that all groups have, at some point, discussed one question, which was not directly laid out by the stimulus, but which is of great importance for learning about environmental economics: '(How) should prices be adjusted, so that they create the right or fair incentives?' In the following, I will first describe why this question is relevant for (learning) environmental economics and how it is tackled in the scientific discipline and then explore different conceptions of teacher trainees.

4 The environmental economics concept: Ecologically 'just' prices

Economists believe that consumers and firms tend to react to prices, in that they usually buy more or produce less of a good, if it is cheap, and vice versa. So price signals are decisive

[4] The question in German has been: Wie Ihr vermutlich wisst, entstehen beim Fliegen umweltschädliche Emissionen. Mich würde interessieren, was Ihr so für Möglichkeiten seht bzw. was man tun könnte, damit weniger umweltschädliche Emissionen durch das Fliegen entstehen und was Ihr von den Ideen haltet bzw. wie Ihr sie beurteilt?

indicators of scarcity, but they can be distorted due to market failures. Market failures are situations in which the market does not allocate resources efficiently (Parkin 2008, 379). The market failure, which is discussed most in environmental economics, is externalities. An externality is an uncompensated loss or gain in the welfare of one party resulting from an activity by another party (Daly/Farley 2010). E.g. air traffic causes greenhouse gas emissions, which can have a negative impact on the environment or health. If the prices for air traffic do not include these externalities, people allocate their resources in a way, which does not maximize the welfare of society. Put differently, if prices are 'too low', people fly more than what would be optimal for society.[5]

Hence, answering the question of how prices should be adjusted in case of an externality, environmental economists advocate changing prices to internalize externalities. This is as a way to integrate ecological costs and benefits in an economic, rational decision-making process. It is important to note that this strategy involves balancing marginal costs of pollution and marginal costs of abatement, i.e. it is based on the idea that there is both a level of pollution, which is too high as well as a level of pollution, which is too low due to societal costs involved in abating pollution.

From a learning perspective this concept involves several challenges. As prerequisite, it is founded on the idea of a market as a mechanism of resource-allocation as well as Pareto-efficiency as a condition in which it is not possible to make one party better-off without making another one worse-off. Furthermore, it is based on the idea of a social planner, i.e. a process, in which societal welfare is optimized by jointly maximizing welfare of consumers and firms. Additionally, it assumes that environmental costs and benefits can be quantified economically as well as that economic and ecological costs and benefits can be substituted.

From an educational science perspective, market failures and externalities can be considered a 'threshold concept', because they are likely to fulfil the five characteristics developed by Meyer/Land (2003). First, they can be *transformative*, because they shift the perception of subjects towards the ideal of an optimal amount of pollution, which is not a commonly held idea as the next section illustrates. Secondly, the concept is *irreversible* as it is probably difficult for people to return to simpler perceptions once they acquire the externality concept. Thirdly, the concept is *integrative*, because it incorporates economic and ecological costs. As the following section will show, most students in the group discussions perceive the two

[5] Cf. Krol (2000) for a more extensive description of externalities.

aspects separately. Fourthly, market failures can be used to show the *boundaries of economics as a subject*. Specifically, they illustrate how economics is mainly concerned with efficiency leaving other criteria such as income distribution aside. Finally, the concept is *troublesome* as it is counter-intuitive to students' previous beliefs (cf. section five).

Externalities are supposed to be covered for the final high school exam according to the curricula of Lower Saxony (Niedersachsen 2006) and Baden-Wurttemberg (Baden-Wuerttembergs' Ministry of Education and the Arts 2004, 255) as well as in the educational standards suggested by Retzmann et al. (2010, 36) and the US Council for Economic Education (2010, 39). Therefore it is fundamental for teachers to understand the concept so that they can teach it to students. The importance given to market failure in educational standards reflects the significance of economic approaches towards ecological problems in real-world politics as in emission trading schemes or policies to subsidize renewable energies.

5 Results: Different conceptions of fair prices by teacher trainees

I find an outcome space with five different conceptions. According to the teacher trainees, price signals should …

1. … be changed to comply with a moral good.
2. … be changed so consumers or enterprises have a fair possibility to opt for an ecological alternative.
3. … be changed so that consumers or enterprises behave in a desired way.
4. … *not* be changed as this would lead to higher costs for the government or the tax payer.
5. … be changed to internalize external effects.

Hereafter, these conceptions will be described in detail and discussed in comparison with the environmental economics concept outlined in section four.

1. Prices should be changed to comply with a moral goal

The statements summarized under this conception are similar in that the need for an adjustment of prices is seen due to moral concerns. Usually these arguments are not specific on how much prices should change or on how the price adjustments affect the actual behavior of the people regulated. What matters is that prices should symbolically recognize correct or punish wrong behavior.

On the structural aspect, two different aspects can be distinguished:

a) Certain actions or behaviors should be rewarded. An exemplary quote is:

I58: So an icing on the cake. It is additionally subsidized by the state. (L B 5, II.1 Solar paint, 315)[6]

Theoretically, one could imagine statements indicating that certain behaviors should be punished. However there are no quotes in the data favoring such a form of punishment.

b) *Legitimate causes*: Certain actions are considered legitimate or illegitimate depending on the motif for the action or the group of people who act in a certain way.

I27: In particular, it is important to focus, what is the reason of my flight in general. In your case, it has a personal reason. And the other has an economic background. Maybe one can say, that one only taxes the business flights. (O Mix, II.1 Air traffic, 64)[7]

This conception has been used more often in the scenarios related to air traffic and organic food. The idea was rewarding companies for the use of fuel-efficient engines, to reward consumers or farmers for buying or growing organic food, or to punish them for not doing so.

Contrary to environmental economics, market-based instruments are named in this conception, but the consequences for market processes, in particular the changes in the incentive structure are not discussed. On the contrary, the focus lies on moral implications.

2. Prices should be changed so consumers or enterprises have a fair possibility to opt for an ecological alternative

The basic problem this conception addresses is that certain ecologically favorable alternatives are more expensive. Therefore it is difficult for people to buy them. The suggestion then is to equal prices between different alternatives for people to be able to select the alternative that is considered to be better from an ecological perspective without being disadvantaged economically.

On the structural level, one can differentiate between two foci.

a) *Equal prices*: Prices should be adapted so that products or services have the same price, if they are considered substitutes. This can concern prices for consumers or enterprises.

[6] Original quote in German: I58: Also, so ein Sahnehäubchen. Es wird noch staatlich gefördert. (L B 5, II.1 Solarfarbe, 315). The letters in the bracket indicate: L for Landau or O for Oldenburg as the place, where the group discussion was conducted; B stands for a group with students at the beginning, A for students at the end of their bachelor/beginning of their master degrees and Mix for the mixed group. Finally, there is an indication of the topic discussed, e.g. Solar paint or Air traffic. The numbers refer to the number of the group discussion and at the end, there is the line number, from which the quote has been taken. Complete transcripts can be requested by contacting the author.

[7] I27: Vor allem kommt es auch dann darauf an, was ist denn, denn überhaupt der Grund meines Fluges. Das ist ja dann bei dir ein persönlicher Grund. Und das andere hat ja dann wirtschaftliche Hintergründe. Dass man vielleicht auch gerade sagt, dass man nur Business-Flüge besteuert. (O Mix, II.1 Flug, 64)

I34: That one sets out conditions, that it is possible with the train, e.g or with the ICE (a German high speed train, DLB), that the people could spontaneously ride it.

Moderator: What do you mean with conditions?

I34: Cheap. So, ugh, prices like airplanes. (L A 1, II.1 Air traffic, 12-14)[8]

b) *Equal utilities*: In the second version, prices for the ecologically less desirable alternatives should be a bit higher as to compensate for disadvantages on other issues such as the amount of time needed:

I31: So, I think, flying ought to be priced in a way where one has to say, `OK, it's a little bit more expensive, but it's quicker.' So, it should be about as expensive as that. That one evaluates and doesn't say: 'OK, just in terms of money, it's worth it. We definitely fly. (L A 1, II.1 Air traffic, 35)[9]

This conception was used in all discussions based on the organic food scenario and in about half of the discussions dealing with emissions in air traffic and the promotion of solar paint.

While the environmental economics idea of adjusting prices to reflect externalities *can* cause prices of substitutable goods to become more similar, this is not a goal per se in economics. Therefore this conception differs significantly from the environmental economics concept. However, this conception seems to match something, which can be observed in real-world environmental politics. Leveling out prices can be an objective, e.g. by aiming to equalize the conditions for different modes of transportation.

3. Prices should be changed so consumers or enterprises behave in a desired way

The arguments in this conception focus explicitly on the actual change of behavior of consumers or enterprises. The major difference from this conception to the others is that it focuses on the real behavior patterns and not on the incentives created by price adjustments. Put differently, in this conception prices should be changed so that the desired change in behavior really takes place, e.g. by making the less ecologically attractive option very unattractive. On the structural level, two aspects can be differentiated:

[8] I34: Dass man so Bedingungen aufstellt, dass es mit dem Zug z. B. oder mit dem ICE auch möglich ist, dass die Menschen dann spontan damit fahren können.
Moderator: Was meinst du mit Bedingungen?
I34: Kostengünstig. Also, äh, die Preise wie beim Flugzeug. (L A 1, II.1 Flug, 12-14)

[9] I31: Also, ich denke, Fliegen müsste im Grunde so teuer sein, dass man abwägen muss: OK, es ist ein bisschen teurer, dafür habe ich den Zeitgewinn. Also, so müsste, ungefähr so teuer müsste es dann sein. Dass man dann abwägt und nicht sagt: Ok, allein finanziell lohnt es sich schon. Wir fliegen auf jeden Fall. (L A 1, II.1 Flug, 35)

a) *Boost ecological alternatives*: Due to price adjustments, an established technology prevails.

I11: For the traditional paint producers, production must become more expensive. So they automatically rethink and say, ok. Only if we can write solar paint on our covers, because we brought in the innovation and reorganized our production technology, THEN we can play in this market. (O B 1, II.2 solar paint, 31)[10]

b) *Technological change*: The prices should be adjusted to lead to increased investments in the development of more environmentally friendly technologies.

I62: [W]ith the adjusted price, ugh, firms, ugh, which e.g. are experimenting with electric motors or so, it's increasing. That might support them, that there are more people, who might say, they invest in a car, which is already powered by electricity. (L B 4, II.1 air traffic, 13)[11]

This conception has been used in all types of scenarios. It is similar to the environmental economics concept as both are based upon the idea, that behavior can be regulated via prices. A main difference, however, is that in environmental economics a price adjustment in favor of an ecologically better alternative is not generally approved. In contrast, environmental economics is always about balancing ecological and economic aspects or societal costs and benefits. Put differently: Environmental economics aims to set incentives as to find an optimal level of pollution and not to force people to use the ecological alternative only. In contrast, this is the main objective of the statements summarized within the third conception.

4. Prices should *not* be changed as this would lead to higher costs for the government or the tax payer

The arguments that were classified in this category reject possible price adjustments due to societal costs. Some of the participants argue that the additional costs would have to be covered by a resource-lacking public authority, while others reject them because they would result in higher tax payments.

[10] I11: Für die klassischen Hersteller von Farben muss es quasi teurer werden. Dass die automatisch umdenken und sagen, ok. Wenn wir aber den Haken Solarfarbe bei uns mit uns auf unseren Deckel mit drauf schreiben können, weil wir diese Innovation da mit hineinbringen und weil wir unsere Produktionstechnik so umstellen, DANN können wir mitspielen auf diesem Markt. (O B 1, II.2 Solarfarbe, 31)

[11] I62: [M]it dem angepassten Preis, ähm, würde äh, Firmen, die zum Beispiel mit Elektromotoren grade experimentieren oder so, kommt ja schon immer mehr. Das würde die vielleicht unterstützen, antreiben, dass es mehr Menschen gibt, die sagen würden, die investieren dann in ein Auto, das jetzt schon elektrisch fährt. (L B 4, II.1 Flug, 13)

I3: The government cannot afford any more tax breaks at all. (O A 1, II.2 Solar paint, 19)[12]

The conception was used in all scenarios, but a bit more often in the solar paint scenario. This might be due to the debate about the costs of subsidizing for solar panels and renewable energies in general in Germany.

From an environmental economics perspective, this conception focuses almost exclusively on the economic side of a problem, being concerned with the economic costs involved while not looking at the ecological costs and possible inefficiencies related to current price signals.

5. Prices should be changed to internalize external effects

This conception aims for the internalization of externalities. It is argued that prices should be changed to reach an efficient allocation or, in more colloquial term, to reflect the 'ecologically-true' costs. Structurally, the arguments in this category focus at the same time on a good or service, which has negative effects on the environment and the necessity to adjust its price so that this is taken into account.

I61: I believe, the only way, (…) would really be a realistic price setting (…) E.g. the transportation costs. They are only cheap at the moment, if we only take into account the current costs. But the consequences of the damages are not included in the calculation. (…) But if one really recognized it as consequences or accept that these are the reasons of transporting things so cheaply. And then calculate the transportation costs, one would quickly reach the conclusion, that it is actually nonsense, to transport things over such long distances. (L B 2, II.1 Air traffic, 7 & 21)[13]

A slightly different version of this conception focuses on the fact that a price adjustment would lead to a situation in which only the people with a higher willingness to pay, i.e. a higher need to have a certain good or service, would get it.

[12] I3: Noch mehr Steuererleichterung kann sich der Staat gar nicht leisten. (O A 1, II.2 Solarfarbe, 19)
[13] I61: Ich glaube, der einzige Weg, (…) wäre eine wirklich realistische Festsetzung von Preis(!). (…) Z. B. die günstigen Transportkosten. Die sind ja auch günstig jetzt in dem Sinne, wenn wir jetzt nur das eine rechnen, was im Moment an Kosten anfällt. Aber die Folgen, von den Schäden werden ja nicht mit einberechnet. (…) Aber würde man das dann wirklich als Folgen erkennen oder das dann annehmen das sind Folgen daraus, dass wir so günstig Sachen transportieren. Und dann mal die Transportkosten ausrechnen würde, dann würde man sehr schnell darauf kommen, dass es eigentlich Schwachsinn ist, Sachen so weit zu transportieren. (L B 2, II.1 Flug, 7 & 21)

I43: So, I believe, flying, because it harms the environment, [is] also a luxury at the expense of society. And to balance it somehow, the people, that do it, should PAY FOR IT. (L B 1, II.2 Air traffic, 30)[14]

This conception has only been used in the air traffic scenario.

As in environmental economics, this conception takes both economic and ecological costs into account and integrates them. Furthermore, the conception uses the observer perspective. According to a competence concept it is desirable for students at the end of their high school studies in economics to use this perspective when dealing with such questions (Retzmann et al., 2010, 17).

Table 1 summarizes the five conceptions with its referential and structural aspect.

Level of complexity	Conception	Referential aspect	Structural aspect
1	1	Moral argument	Focus on ethical reasons for a certain behaviour
2	2	Create freedom of choices	Focus on equalizing prices of consumption or production alternatives
2	3	Change behaviour	Focus on the harmful activity
2	4	Changes are rejected due to economic costs	Focus on the costs of the government or the tax payer
3	5	Internalise external effects	Focus on the harmful activity *and* the costs of government or the tax payer

Table 1: Different conceptions to the question, how prices should be adjusted.

Source: Author's own table.

6 Discussion and suggestions for teacher training

The conceptions of the teacher trainees found in this research can be differentiated on three levels of complexity (cf. Table 1). Conceptions on the first level only focus on ethical arguments. They cannot easily be linked to ideas used in environmental economics and can therefore be considered non-economic. Conceptions two to four are on the second level as they take up some elements of the Environmental Economic concept by focusing either on the ecological or the economic costs and benefit. They are partial conceptions of the

[14] I43: Also, ich finde, Fliegen dadurch, dass es ja schon die Umwelt sehr arg belastet, ist irgendwie ja auch ein Luxus auf Kosten der Gesellschaft, und um das dann irgendwie auszugleichen, sollte es halt dann, also die Leute, die das machen, sollten es halt BEZAHLEN. (L B 1, II.2 Flug, 30)

complex environmental economics concept. Only the 5th conception can be placed at the highest level of complexity as it combines a focus on economic as well as ecological costs and benefits or, put differently, on the harmful activity *and* the costs, which result from a regulation. The structure of the result is similar to the phenomenographic research on price, where conceptions are differentiated on three levels as well: Reflecting (a) the value of the object, (b) the demand *or* supply characteristics or (c) both the demand and supply characteristics (Marton/Pong 2005; Pong 1999).

Table 2 depicts the relative frequencies of the conceptions in total as well as distinguished between how long students have studied and whether they study in Oldenburg or Landau.

Conception	Total	Beginner	Advanced	Oldenburg	Landau
(1) Complying with a moral good	38 %	45 %	20 %	36 %	39 %
(2) A fair possibility to opt for an ecological alternative	56 %	55 %	50 %	57 %	56 %
(3) Force a behavioral change	41 %	50 %	30 %	43 %	39 %
(4) No change because of costs for government/tax payer	28 %	30 %	20 %	36 %	22 %
(5) Internalize external effects	13 %	10 %	10 %	7 %	17 %

Frequencies are based on counting in how many discussions a respective category was used at least once. Due to the qualitative nature of the study and to the data collection via group discussions, there was no differentiation whether a category has been assigned several times once or several times during a single group discussion. As two scenarios have been debated in every group, there were 32 discussions in total, 20 beginner, ten advanced, and two mixed group discussions. 14 discussions have been conducted in Oldenburg, 18 in Landau.

Table 2: Relative frequencies of the conceptions
Source: Author's own table.

Because of the relatively small sample size, I have not performed inferential statistics. Nonetheless, a glimpse at table 2 already reveals some interesting insights. The most complex conception (5) has been used in fewer group discussions than all the other conceptions. As more groups have used conceptions (2) and (3) than conception (4), I cautiously infer that teacher trainees seem to focus more on price adjustments as possibilities to change behaviour than at the costs to society. There is not much difference between groups beginning and finishing their studies, besides that the beginners have used the moral concept twice as

much as the advanced groups. It is surprising that the concept of internalization has been used so rarely in the advanced groups, even though that in each of the advanced groups at least two students claimed to have covered environmental contents in their economics courses.[15] It is beyond the scope of this paper to speculate, why the advanced groups have seldom used the concept of internalization. Groups in Oldenburg have focussed more often on the costs for government or the tax payer. The complex conception (5) has been brought up a bit more often in Landau.

The rare use of the complex conception is in line with Remmele (2009) and Birke/Seeber (2014): Students seem to have great difficulties to use a systematic view, which involves in the present study looking at both the incentives and the costs.

Using these results, some tentative conclusions can be drawn for teacher training.

Many teacher trainees seem to have difficulties in recognizing and handling the contradictions inherent in almost any policy measure for the environment, i.e. when there is a need for regulation, a measure that is good for the environment is usually bad for the economy and vice versa. That this is challenging for students to grasp becomes evident when analyzing situations where participants inside an individual group hold different opinions, whether one should change prices for ecological concerns or one should not do so because of the costs to society. In many of the groups the teacher trainees stuck to their initial opinions instead of looking for a way to balance the two positions. Therefore a didactical intervention seems necessary making students aware that environmental economics aims to balance economic and ecological concerns. Thereby, they should be able to improve their understanding from the second to the third level (cf. table 1).

In order to reach the desired complex perspective in a learning process, I suggest a learning path based on variation theory (cf. section 3).

The learning path is similar to an approach frequently applied in economics textbooks, but embedded in a different didactical setting. Firstly, a situation with two companies and an ecological externality is described. Students are asked to argue economically about the pros and cons of a command and control instrument such as a standard vs. a market-based instrument such as a tax. Afterwards, their awareness is directed towards the first critical aspect:

[15] Students filled in a questionnaire at the end of the group discussions. Among other things, they were asked, whether and, if so, in which courses they have covered environmental or sustainability issues. The number of two or more students in the advanced classes only refers to sustainability courses either in Economics, such as environmental economics or in economic education.

The cost differential. Therefore two situations with two companies are compared by numerical and graphical representation. In the first situation both companies have the same, in the second, different marginal abatement costs. Students thereby identify that the market-based instrument has lower costs, if marginal costs of abatement differ.[16] In the second step, the focus is put on different incentive structures, i.e. the other critical aspect. This can be illustrated by a variation of tax rates or different standards. To enable students to generalize what they have learned, they compare situations where neither marginal costs nor tax rates or standards differ, but only other aspects such as the size of the companies or the price of the product they are selling. Students should hereby learn to focus on the critical aspects. At this point, it should be reflected that economic policy measures for the environment can improve the ecological situation, but usually at an economic price. This should create some dissatisfaction in students seeing the need for a new concept to handle the contradiction. In the conceptual change literature such a dissatisfaction is often seen as a prerequisite for learners to acquire new concepts (Strike/Posner 1992). Finally, there should be a joint variation: students could be asked to argue what would change, if, in the future, abatement technologies become cheaper, but at the same time new scientific studies show that more ambitious reductions in emissions are needed.

Additionally, it seems necessary to reflect with teacher trainees the distinct features of the environmental economics approach towards ecological problems and how it differs from non-economic approaches, which take a clear stand either in favor of the environment or the economy. A possible didactical setting could be based on comparing positions concerning the fossilfuel phase-out between an environmental organization, the industry, and the government.

7 Conclusions

The main research question in this article has been: How should prices be changed in case of an environmental externality? This article found five different ways, which teacher trainees in economics in two German universities, address this question. The first conception wants price signals to be changed to comply with a moral good. This is a non-economic argument. On the second level (conceptions two to four), focus is put either on the change of an incentive structure or on the costs to the tax payer. Only the fifth and most complex conception is

[16] This conclusion assumes: (1) Different marginal abatement costs, (2) homogeneity in marginal damages, (3) no transaction or control costs, (4) no threshold or tipping points are crossed because of the emissions.

similar to the externality concept from environmental economics by focusing both on the incentives and the costs or, put differently, by balancing ecological and economic costs. This hierarchical structure, where the most complex conception integrates the conceptions on the second level, is similar to other phenomenographic research in economic education. Furthermore, the present research supports the assumption that taking a systemic perspective is challenging for learners as the fifth conception is used in fewer groups than the others.

As the externality concept is central in environmental economics, but has only been used in one out of ten discussions both in beginner and advanced groups, this paper has suggested a possible learning path for the externality concept based on students' preconceptions.

Possible further research could focus on estimating the prevalence of the different conceptions in a representative sample of teacher trainees and on comparing different teaching methods for the externality concept.

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Annex

Scenarios type II.1: Economic instruments and value criteria

Thema/ Topic	Stimuli	Stimuli
Emissionen/ Emissions	Wie Ihr vermutlich wisst, wird der Klimawandel durch den Ausstoß von Treibhausgasen gefördert. Mich würde nun interessieren, was Ihr so für Ideen habt oder kennt, was man tun könnte, um den Ausstoß von Treibhausgasen zu reduzieren und was Ihr von den Ideen haltet bzw. wie Ihr sie beurteilt?	As you probably know, the emission of greenhouse gases contributes to climate change. So, I would be curious to know what ideas you have, what one could do, to reduce greenhouse gas emissions and what you think about the ideas or how you judge them?
Solarfarbe/ Solar paint	Wie Ihr vielleicht mitbekommen habt, haben Forscher eine Spezialfarbe entwickelt. Wenn man diese an Außenwände streicht, kann damit Sonnenlicht in Energie umgewandelt werden. Mich würde interessieren, was Ihr so für Ideen habt, was man tun könnte, damit diese Farbe genutzt wird und was Ihr von den Ideen haltet bzw. wie Ihr sie beurteilt?	As you might have heard, scientists have developed a special paint. When one applies it to outdoor walls, it can transform sunlight into energy. So, I would be curious to know what ideas you have, what one could do so that this paint gets used and what you think about the ideas or how you judge them?
Emissionen im Flugverkehr/ Emissions in air traffic	Wie Ihr vermutlich wisst, entstehen beim Fliegen umweltschädliche Emissionen. Mich würde interessieren, was Ihr so für Möglichkeiten seht bzw. was man tun könnte, damit weniger umweltschädliche Emissionen durch das Fliegen entstehen und was Ihr von den Ideen haltet bzw. wie Ihr sie beurteilt?	As you probably know, environmentally harmful emissions arise out of air traffic. So, I would be curious to know what ideas you have, what one could do to reduce environmentally harmful emissions in air traffic and what you think about the ideas or how you would judge them?
Ökolebensmittel/ Organic food	Wie Ihr vielleicht wisst, ist der Anteil von ökologisch produzierten Lebensmitteln an den insgesamt produzierten Lebensmitteln recht gering. Mich würde interessieren, was Ihr so für Ideen habt, was man tun könnte, damit mehr ökologisch produzierte Lebensmittel hergestellt werden und was Ihr von den Ideen haltet bzw. wie Ihr sie beurteilt?	As you might know, the share of organic food in total food production is pretty low. So, I would be curious to know what ideas you have, what one could do so that more organic food is produced and what you think about the ideas or how you judge them?

Source: Author's own table.

Scenarios type II.2: Comparing and evaluating economic instruments

Thema/ Topic	Stimuli	Stimuli
Solarfarbe/ Solar paint	Wie Ihr vielleicht mitbekommen habt, haben Forscher eine neue Spezialfarbe entwickelt, die Sonnenlicht in Energie umwandeln kann. Was haltet Ihr von folgenden Maßnahmen, um diese Technologie zu fördern? Wenn Ihr Ideen habt, wie man diese Maßnahmen besser gestalten könnte, könnt Ihr diese natürlich auch äußern. 1. Durch eine Informationskampagne wird die Bevölkerung über die Vorteile der neuen Farbe informiert. 2. Ab Anfang 2015 darf nur noch die Spezialfarbe verkauft werden. Alle anderen Außenfarben werden verboten. 3. Jeder Hausbesitzer, der die Spezialfarbe benutzt, bekommt für fünf Jahre eine Steuererleichterung. 4. Die Farbproduzenten bekommen in den nächsten fünf Jahren eine Prämie für jeden verkauften Liter der neuen Spezialfarbe. 5. Die Farbindustrie wird verpflichtet Schadstoffzertifikate zu kaufen: Für jeden Liter Farbe, der Schadstoffe enthält, muss sie ein solches Zertifikat nachweisen. Für schadstofffreie oder energieleitende Farbe müssen keine Zertifikate erworben werden. Die Zahl der zur Verfügung stehenden Zertifikate wird jedes Jahr reduziert.	As you might have heard, scientists have developed a special paint, which can transform sunlight into energy. What do you think of the following measures to promote this technology? In case, you have ideas on how to improve these measures, you are of course welcome to express them as well. 1. Through an information campaign, the population is informed about the advantages of the new paint. 2. Starting at the beginning of 2015 only the special paint may be sold. All other outdoor paints will be prohibited. 3. Each landlord, who uses the special paint, will be granted a tax relief for five years. 4. Each paint producer will receive a premium for every liter of special paint sold within the next five years. 5. The paint industry will be obliged to buy tradable emission permits: For every liter of paint, which contains pollutants, they will have to present such a permit. For unpolluted or energy conducting paint, no permits have to be bought. The number of available permits will be reduced every year.

Flugverkehr/ Air traffic	Wie Ihr vermutlich wisst, entstehen im Flugverkehr umweltschädliche Emissionen. Was haltet Ihr von folgenden Maßnahmen, um die Emissionen im Flugverkehr zu begrenzen? Wenn Ihr andere Ideen habt oder Vorschläge, wie man diese Maßnahmen besser gestalten könnte, könnt Ihr diese natürlich auch äußern.	As you probably know, environmentally harmful emissions arise out of aviation. What do you think of the following measures to limit emissions in aviation? In case, you have ideas on how to improve these measures, you are of course welcome to express them as well.
	1. Durch eine Informationskampagne wird die Bevölkerung über die Klimaschädlichkeit des Fliegens und über ökologischere Alternativen informiert. 2. Flüge werden auf Strecken verboten, auf denen die Bahn weniger als sechs Stunden benötigt. 3. Die Flughafengebühr, die jede_r Reisende entrichten muss, wird erhöht. 4. Die Besteuerung von Flugbenzin bzw. Kerosin wird angehoben. 5. Alle Fluglinien werden verpflichtet, CO_2-Zertifikate zu kaufen: Für jede Tonne CO_2, die sie ausstoßen, müssen sie ein solches Zertifikat kaufen. Die Zahl der zur Verfügung stehenden Zertifikate wird jedes Jahr reduziert.	1. Through an information campaign, the population is informed about the negative consequences to climate change due to aviation and about more ecological alternatives. 2. Flying will be prohibited on routes on which railways need less than six hours. 3. The airport tax, which every traveler has to pay, will be increased. 4. The taxes on jet fuel or kerosene will be increased. 5. The airline companies will be obliged to buy CO_2 tradable emission permits: For every ton of CO_2, which they emit, they will have to buy such a permit. The number of available permits will be reduced every year.

Source: Author's own table