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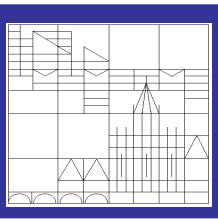

How to Improve Economic Understanding?

Testing Classroom Experiments in High Schools

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How to Improve Economic Understanding? Testing Classroom Experiments in High Schools*

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Abstract: We present results from a field experiment at Swiss high schools in which we compare the effectiveness of a classroom experiment against conventional economics teaching. We randomly assigned classes into different teaching environments or a control group. Our results suggest that both teaching methods improve economic understanding considerably in contrast to classes without prior training. We do not observe a significant overall effect of the classroom experiment, but more able students benefit from the experiment while others lose out. Furthermore there is no robust impact of economic training on social preferences, measured as both individual behavior in incentivized decisions or political opinions.

JEL Classification: A21, C93, I21

Keywords: Education of Economics, Classroom Experiments, Field Experiments, Indoctrination

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I. Introduction

While classroom experiments are perennially popular in the natural sciences, scholars of economic sciences promote this teaching instrument since only recently (e.g. Bergstrom and Miller, 2000). On the notion that rather abstract economic theory is best understood through actual application, various kinds of experiments were developed to demonstrate certain characteristics of economic interactions.[1] Unlike experiments in physics or chemistry, however, economic classroom experiments rely on introspection, and as such students are not merely spectators but active participants in the investigation themselves. It is argued that this participatory experience enhances students' interest into economics and thus stimulates learning more effectively than conventional instruction (e.g. Becker and Watts, 1998; Walstad and Saunders, 1998; Kolb, 1983). Yet student behavior may also contradict economic assumptions, causing harm to both the reputation of teachers and economic theory. In the early 1990s, Fels (1993) pointed out the irony that no proponent of classroom experiments had performed a controlled study to evaluate the impact of this teaching method, and that conclusion was drawn primarily from anecdotal evidence. Since then, some effort has been put into closing that research gap (Cardell et al., 1996; Gremmen and Potters, 1997; Frank, 1997; Cebula and Toma, 2002; Emerson and Taylor, 2004, 2007; Dickie, 2006; Ball et al., 2006; Durham et al., 2007; Mitchell, 2008; Dufwenberg and Swarthout, 2009). However, a systematic evaluation at education levels other than universities is missing.

We address this issue within a comprehensive field experiment at high schools. Economics at the upper secondary level is typically part of an integrated curriculum. Hence, the composition of the student body is less selective in high schools than in undergraduate economics courses at universities. Educational environments are varying, too. Classes, for example, can easily account for over one hundred students in tertiary education. In upper secondary schools these figures are typically in the lower twenties. In addition, university teachers increasingly rely on experiments in their own research, and thus might be more receptive to the methodological value of experiments as a teaching instrument. Apart from concentrating on a different education level, existing studies also face methodological drawbacks that we address later in this introduction.[2] These drawbacks relate to the role of teachers. Most of these studies involve only few teachers and rarely are they assigned randomly into different educational settings. Some authors also participated as teachers in their own studies, which is challenging an unprejudiced judgement.

Our data comes from several high schools in the German-speaking part of Switzerland. 31

[1] There is certainly no shortage in interactive teaching concepts. Some are already used in undergraduate and graduate courses in higher education, and new proposals for classroom experiments appear frequently (Rojas, 2011; Diduch, 2010; Gächter and Königstein, 2009; Basuchoudhary et al., 2008; Pickhardt, 2005; Holt and Laury, 1997). However, there are only few tailored to the level of secondary education. Readers who like to conduct classroom experiments on their own find plenty of useful information in Holt (1999) or Bergstrom and Miller (2000), whereas Dickie (2006) and Cheung and Fujii (2006) discuss the problem of adequate incentives in particular.

[2] Most of the systematic evidence in educational research is derived from meta-analyses (Fraser et al., 1987; Scheerens and Bosker, 1997; Seidel and Shavelson, 2007). The studies discussed therein rarely make use of controlled experiments and largely ignore the impact of self-selection.

teachers participated with 42 classes, totaling in 720 students observed. We randomly assigned the classes into different teaching contexts. One group of classes received no instructions prior to the evaluation. This we label the *Control* group. A second group participated in a classroom experiment on the matter of common-pool resources (CPR) problems while keeping to standardized instructions for a follow-up lesson on the same topic. This set of instructions comprised worksheets with comprehension questions, a summary text with various examples of CPR problems as well as a case-study illustrating the problem of overfishing. We refer to this as the *Experiment* group. Classes of a third group also relied on the aforementioned set of instructions, but instead of carrying out the experiment we requested teachers to prepare an introductory lecture on the nature of CPR problems on their own. This is denoted the *Standard* group. Thus, we compare the effectiveness of a classroom experiment in comparison to common (non-experimental) teaching practices. Treatment effects are captured threefold: students' performance in a test of economic understanding, social preferences in the form of both individual behavior in incentivized economic decisions and statements on political views, and an assessment of experimental and conventional instruction from participating teachers.

We took great care to ensure a conservative identification of differences between treatment groups. First, we investigated economic understanding rather than knowledge of economic terminology by using jargon-free language. For this we rely on our own set of test questions in which students are asked specifically on those domains that relate to our teaching instructions. Second, teachers of both treatment groups were required to spend the same amount of time teaching on this particular subject. Hence, we also capture the opportunity costs of classroom experiments. Third, teachers of the Standard group were given a reasonable amount of leeway in doing so. Their sole confinement was a strict prohibition of the conduct of any type of classroom experiment. Last, we ensured that there was always at least one working day and a weekend between a treatment intervention and the evaluation.

Our study extends on two different areas independently. First and foremost, we provide evidence on the effectiveness of experimental instruction in economics, which is typically measured by the treatment differences in student test scores. Many researches rely on the standardized Test of Understanding in College Economic (TUCE). In some cases this test allows to draw comparisons in effect sizes between different studies, but it might fail to capture the essence of what was taught in class and thus only vaguely reflect true learning effects. While scholars like Becker (1997) criticize the validity of such a crude measure quite generally, reliance on this approach seems appropriate in particular when the experimental group is exposed to a series of classroom experiments on different topics, and over a longer period of time.

One of those studies is Emerson and Taylor (2004). In a rather comprehensive endeavor, they observe how students in two experiment sections (59 students) and seven lecture-oriented sections (241 students) prevail in the microeconomics portion of the TUCE. Eleven pencil and paper experiments were drawn from the Bergstrom and Miller (2000) textbook. Their main finding is a significant improvement in the test score for participants of the experiment group

while also controlling for various student characteristics.[3] A largely similar approach is followed in Dickie (2006). Using a sample of 142 students and a set of seven microeconomics experiments, TUCE score improvements are significantly larger in the experimental group, but adding grade incentives for success in the experiments negatively impacts these benefits. Some evidence is also found that higher-achieving students experience the largest benefits from the experimental approach, and in that his results contradict previous findings by Emerson and Taylor (2004).

Durham et al. (2007) also investigate multiple economic concepts experimentally. The authors, however, diverge from the above studies in two important domains. Not only did they observe both micro- and macroeconomic issues, they also created their own instrument with the intent to measure more precisely whether students are learning what the experiments were designed to teach. The authors included eight introductory microeconomics and eight introductory macroeconomics sections, totaling in 1585 student participants. Their results too indicate that classroom experiments improve student performance. In addition, they also look into how these gains vary across students with different learning styles. Here they observe that benefits apply differently. In particular, multimodal and kinesthetic learners, who together account for over 85% of all of their students, significantly improved performance with the use of experiments in comparison to traditional lecture-style teaching. Similarly, Ball et al. (2006) also rely on their own instrument using exam scores. Their particular innovation lies in the observation of a wireless interactive teaching system, which is arguably better suited for experiments in large classes. They too report a (weakly significant) positive overall effect. They also find that experiments have generated a larger impact on freshmen, a cohort—although exposed distinctively to self-selection—with similar economic experience as students from our sample.

In terms of instructional content, the study by Frank (1997) is the most similar to ours, as he observes the efficacy of a single experiment in lectures on the "tragedy of the commons". Participating teachers gave their usual lecture on the topic and evaluation followed right after, except for the experiment group that carried out a five to ten minutes game in between. Only few students of each experiment group actually participate in the classroom game while the large majority was expected to learn from their behavior. Limited evidence is provided that such a teaching practice yields benefits.

We have shown that there is a general tone of sympathy towards experimental instruction in these previous studies.[4] Cardell et al. (1996), Mitchell (2008), and Dufwenberg and Swarthout (2009) do not identify a positive effect of classroom experiments. To our knowledge, there is no study finding an overall negative effect of experiments on students' performance.

Apart from the contribution to the education of economics literature our study is the first

[3] In a follow-up study on the same data, Emerson and Taylor (2007) furthermore observed whether associations exist between students' personality types and performance in economics classes. Results indicate that experiments benefit, or are at least neutral with respect to many of the 16 Myers-Briggs type indicators.

[4] Evidence from classroom experiments in subjects other than economics indicate that they are beneficial for developing reading skills (Fraser, Walberg, Welch, and Hattie, 1987), and for improving the understanding of natural sciences. Yet even in the latter context, evidence is not unambiguous (e.g. Kirschner and Huisman, 1998).

to investigate systematically the role of teaching methods as a source of indoctrination. With their strong emphasis on free-riding incentives, both of our teaching interventions might cause participants to display a more accentuated behavior of self-interest in our set of incentivized economic decisions. First-hand experiences on the effectiveness of self-serving strategies might cause students of the Experiment group to internalize such behavior even more strongly.

Several studies suggest that students of economics tend to behave more selfishly than other people (e.g. Marwell and Ames, 1981; Carter and Irons, 1991; Frank et al., 1993; Selten and Ockenfels, 1998; Frank and Schulze, 2000). But to what extent self-interested behavior is due to instruction rather than selection into the economics discipline, is a matter of ongoing debate. Frey and Meier (2003) provide evidence from a natural setting. They study voluntary donation behavior into two social funds of the University of Zurich. They conclude that the willingness to donate decreases generally over the time students (of any major) are enlisted. Significantly lower contribution by students of business administration seem due to self-selection rather than indoctrination. Moreover, students with a history of economic education in high schools give less as well (although the authors miss the opportunity to control for interaction effects between pre-university economic education and major field of study). Bauman and Rose (2011) confirm these findings. They take a very similar approach observing voluntary contributions to social programs of the University of Washington. In contrast to the previous study, the authors are able to control for non-major students who nonetheless took courses in microeconomics. Economics majors appear less pro-social but unaffected by indoctrination. Interestingly though, economics training seems to have an indoctrination effect on non-majors as these students reduce contribution if introductory or intermediate microeconomics courses had been attended.

The paper is structured as follows: In the next section we introduce our research design in greater detail. In section 3 we present our predictions. Section 4 provides the data and section 5 the results. Section 6 summarizes and concludes.

II. Design and Procedures

We describe essential features of our treatment interventions at first and deal with the evaluation procedure—which is the same for all participants—in the following. We then present information regarding the recruiting procedure and the random assignment of classes into control or treatment groups, and conclude with a description of our sample selection.

II.1. Treatment Interventions

We have a *Control* group and two teaching treatments. We deliberately altered didactic instruments in the two teaching treatments in order to identify the effect of classroom experiments on individual learning. The inclusion of a Control group provides a reference point for comparing

knowledge acquisition and behavioral change. For that reason, students in the Control group only participated in the test and the questionnaire, which are detailed below.

In both teaching treatments teachers relied on material from a teaching module on common-pool resources (CPR) problems provided by the Swiss National Bank.[5] This teaching module was developed in close cooperation with educational experts and covers a rather broad range of aspects. For example, it consists not only of standard solutions to CPR problems—i.e. privatization or governmental control—but also incorporates the role of social norms, collective decision-making or collective sanctioning. Teachers participating in treatment sessions obtained the same overall teaching goals. In particular, students received instructions on distinctive features of CPR goods and the predicaments arising from the incentive structure. Educational objectives aimed at the identification of situations that share similarities with typical CPR problems, anticipating behavior of rationally thinking and (potentially) self-serving individuals within various institutional environments, and proposing solutions to the problem of overexploitation. Teachers were encouraged to spend two lessons (of 45 minutes each) on the topic, which is a rather typical dimension for lecturing in a particular subject. We provided a package with all necessary teaching material in advance. Common to both treatments were worksheets for students with comprehension questions and a sample solution for teachers as well as a summary text for students, with various examples and a recapitulation of key aspects of CPR problems. We also provided teachers with overhead transparencies for a case-study illustrating the problem of overfishing in the Atlantic sea. A cover letter accompanied the package, including a step-by-step guideline for all necessary procedures and other aspects worthy of note.

In the *Experiment* treatment, teachers carried out the module as intended by the Swiss National Bank. This means that approximately one lesson was used for the classroom experiment while the remaining 45 minutes were spent deepening the theoretical understanding for CPR problems (based on the case study and other material mentioned above). The classroom experiment resembles an interactive fishing game that mirrors the incentive structure of a CPR problem. Specifically, students make anonymous claims for various amounts of fish per round (non-excludability) but fishing a higher quota than what the regeneration process allows leads fish to die out early (rivalry in consumption). At the beginning of the game, the pond contains four fish per player whereas in each of the 10 rounds, every player may catch between zero and three fish anonymously (by wearing masks). The number of fish remaining in the pond doubles between rounds. However, there is a capacity limit. The pond cannot hold more than four fish per player. Students are told that they can win the game only by catching the most fish of all participants. Succeeding in the game is incentivized by providing sweets or comparable low-value goods for the winner(s). As such, profit maximizing participants have an incentive to

[5]The corresponding teaching platform is accessible online under *www.iconomix.ch*. It is described as a web-based tool used in the teaching of economics. It offers a range of teaching units that can be either downloaded or ordered. It is primarily intended for use by teachers of economics and humanities at upper secondary schools. It sees itself as "the ideal complement to today's teaching resources" as it allows you to easily put together interesting, enjoyable, task-based lessons on economics.

exceed the sustainable quota to the detriment of the others. The game features three variations comprising the above standard situation, a situation with the option to punish the action of others while in turn bearing individual costs, and a situation where students can call a class conference and formulate non-binding agreements whenever they see fit. The standard situation was mandatory while the other two variants were optional. The game is neutral in framing in order to provide an experience free of any moral or social prejudice and as such does not depend on a specific real-world problem. After having completed the game, students were made aware of the severity of CPR problems in real-world situations by introducing them to the above mentioned case-study on the collapse of Atlantic cod stocks. The outcome of the game was discussed in the light of this particular issue while working through the comprehension questions and the summary text allowed students to deepen their understanding of CPR problems in a range of different contexts.

Classes in the *Standard* treatment did not participate in the above classroom experiment. Other than that, teaching goals and material was the same as described earlier. Specifically, teachers were encouraged to start their lesson with the previously mentioned case-study and to work through the same exercises and to read the same résumé. Stripping teachers from the obligation to conduct the classroom experiment, however, frees up some time. This is why for the reminder of the two lessons they were free to choose the most suitable way to teach the subject. We deliberately conceded this amount of freedom in order to establish a credible common practice comparison for the classroom experiment. The only constraint was that teachers must not play any sort of classroom games in order to keep the treatment groups separate. About halve of all teachers reportedly used newspaper articles, movie segments or chapters out of a book to complement their lesson. The other halve preferred not to supplement their lesson with additional material but instead spent more time deliberating on the case-study, discussing the worksheets and/or the summary text. Learning success therefore comes from students being exposed to a teachers' best practice approach to a lecture-oriented lesson with a well-defined educational objective.

In addition to treatment-specific instructions, each teacher received a questionnaire comprising standardized questions. This questionnaire was handed out in two parts. Whereas the first part was identical between both treatments and the Control group, the second was targeted on treatment-specific attributes only. Questions common to all treatments were meant to capture general characteristics of the class under evaluation. Treatment-specific questions allowed for a comparison of measured learning achievements through CPR test scores with the teachers' subjective view on the success of their lesson. Teachers' feedback also provided valuable information on the effort invested into preparing their lesson or the way instructions were implemented. All material students or teachers received for this study is provided in the appendix.

II.2. Evaluation Procedure

The completion of both the test and the questionnaire took no longer than 45 minutes and was supervised by one of the authors together with the economics teacher of the respective class. The procedure was as follows: After a standardized introduction we handed out tests and questionnaires simultaneously. Both were marked with unique random numbers in order to guarantee full anonymity. Students were told to start with the tests. These were collected after a predefined time limit. Students then continued with the questionnaire. On average, a student received 14.3 Swiss francs (about EUR 9.6 or USD 13.7 over the observation period). Payment was handed out anonymously in sealed envelopes, labeled with the above mentioned random numbers, a couple of days later. For both the test and the questionnaire we conducted pretests with comparable students.

Test of Economic Understanding

All subjects (students) took part in our 12 minutes test of economic understanding. They faced statements on the subject of CPR problems as well as on questions unrelated to this matter, like bargaining, the interplay of demand and supply, or effects of market interferences. Students then had to decide whether a statement was correct or false. Appropriate responses were rewarded with 0.1 Swiss francs each.[6] To discourage guessing, any false answer led to an equivalent deduction in payment. No money was deducted if one failed to respond or ticked the "I do not know" checkbox, nor was it possible to close with a deficit. Students faced 30 statements on the grounds of eight different situations, between two and five per situation. Out of these, 17 statements (4 situations) focused on CPR problems while 13 statements (4 situations) elaborated on a more general nature of economic understanding.

All multiple choice questions are self-developed by the authors and use jargon-free language. The validity of these statements has been thoroughly examined in two pretests at comparable high schools. Many related studies administer a selection of test questions from the Test of Understanding in College Economic (TUCE) to measure student learning. The rather general nature of the TUCE, however, is not advisable in our case since we aim to observe learning in a single and very specific domain. In addition, our sample consists of high school students, and as such, they bring with them quite a different level of economic understanding to begin with. We are not aware of any existing standardized measure that addresses our topic while being suitable for high school students, let alone for Swiss or European students in particular. Existing studies on the effectiveness of classroom experiments exclusively deal with university students from the US. For all these reasons, we chose to develop our own measure of economic understanding. No instructor in either the treatment or Control groups was given access to the test questions in advance and thus deliberate teaching to the test was not possible.

[6] One Swiss franc could buy about EUR 0.67 or USD 0.96 in winter 2009/2010 when the study was conducted.

We retain our measure of individual test performance by aggregating a student's position on CPR statements. Specifically, we apply the *formula scoring* method, which was found to be more reliable than *number-right scoring* (Muijtjens et al., 1999).[7] With this procedure a "I do not know" checkbox is added to the answering options, and the number of correct minus incorrect answers is used as the test score. As a consequence, the "I do not know" option reveals additional information about the quality of a statement. For example, a relatively large percentage of "I do not know" answers may indicate that the statement was not part of the teaching intervention or that initially the statement was poorly formulated. A disadvantage of this approach is that students might tend to omit statements which they would have had a better than random chance of answering correctly had they guessed. This penalizes more able students (Bliss, 1980).

Questionnaire

After completing the test, students were required to fill in a questionnaire. This questionnaire was split into three different segments: incentivized economic decisions, students' political view, and their socio-economic background.

The segment on incentivized economic decisions replicated standard economic experiments on social preferences. At first, students participated in a public good game where each student was endowed with three points at the outset. Student then could keep their endowment or transfer all or parts of it into a public cash box. The points total in the cash box was then doubled and back-transferred in equal shares to all class members, regardless of their initial contribution. In addition, we also conducted a simple distribution game (or "envy" game), a dictator game, an ultimatum game, and a trust game. For the latter two games, we randomly divided students in each class in first and second movers. In both the distribution game an the dictator game, each student could transfer between 0 and 9 points to another class member whereas own income was kept constant at 4.5 points in the former. For both of our two-party games equivalent transfers were restricted to the first movers only. Second movers where either encouraged to reject any (subjectively) unacceptable split in the ultimatum game or to reciprocate trustful behavior as desired. In all these games, the framing was neutral and the exchange rate for 1 ECU was 0.3 Swiss francs.

In the second segment we asked students about their political view on a variety of topics. Specifically, we queried them on their stance on carbon emission surcharges for airline tickets, agricultural subsidies, health insurance regulations, subsidies for investments in green technologies, free trade, social security, and fishing regulations. All topics reflect either rather prominent topics in Swiss politics at that time and/or aspects of relevance in the light of our treatments. Thus, the first two segments capture eventual side effects of our treatment interventions on both preferences and behavior. Information on a participants' socio-economic background is

[7] *Number-right scoring* provides only answering options for right and wrong while the sum total of all correctly answered statements defines the score.

used to identify potential shortcomings of the randomization procedure and allows insight into how distinct sub-groups of students are learning differently.

II.3. Recruiting and Random Assignment

We contacted 79 eligible schools in late summer 2009 in written form. We addressed both the head of the school as well as the head of the faculty of economics. Ultimately, 31 teachers from 29 schools confirmed to participate, supplying 42 classes in total. Schools received information that participating classes will either take part as a Control group or a treatment group that involved two lessons of teaching. Teachers interested in our field experiment had to confirm their participation before they learned about their group assignment. Once we received confirmation of participation, we tried to get equally large experimental groups by applying the following randomization procedure: The first participating class was assigned to the Standard treatment, the second to the Experiment treatment, and the third to the Control group. This sequence was repeated until every class was properly attributed with a group. After assignment was complete, we arranged dates for the teaching treatments as well as for the standardized evaluation procedure. We demanded at least one weekend and one working day lying in between the treatment and the evaluation date, with a maximum of 10 days. The most common arrangement was to carry-out the treatment in two consecutive lessons with the evaluation following exactly one week later. Both treatment interventions and the subsequent evaluation were carried out between October 2009 and March 2010. Teaching material was sent by mail two weeks prior to the start of a teaching treatment. Any treatment or control session was carried out by the economics teacher of the respective class.

II.4. Sample Selection

We conducted our study in the German-speaking area of Switzerland. We exclusively evaluated students taking economics classes in upper secondary schools of the type "Kantonsschule/Gymnasium" (ISCED 3a).[8] These schools are authorized to prepare students for a university education and as such comprise about the top 20% of students in a cohort.[9] They are comparable to academic high schools or grammar schools in other countries. Federal law branches out the structure of this type of school into distinct profiles.[10] For that reason, curricula may differ considerably due to students' self-selection into *Physics and Mathematics*, *Biology and Chemistry*, *Modern Languages*, or *Law and Economics*, as well as other less popular profiles.[11] Economic education is typically part of the corresponding profile and as such compulsory,

[8] ISCED: International Standard Classification of Education.

[9] See Federal Statistical Office (2012).

[10] Federal law also defines the educational goal, the quality of the teaching body, and the duration of schooling. Cantons (the member states) have a fair amount of freedom in the actual organizing of their education system. Students of this type of school commonly attend the one closest to their vicinity.

[11] See Maturitäts-Anerkennungsverordnung. Schools are not obliged to run the complete range of profiles at their campus. Other profiles are ancient languages (Greek, Latin), music, or arts and crafts.

or it is eligible as a compulsory choice subject, which is a subject a student is free to choose out of a given set of alternatives, whereas making the choice is a compulsory action.[12] To assure a high level of comparability, our sample consists of students from the law and economics profile only.

Such a sample is starkly different from a random draw of economics students at universities. After all, just about ever second university student of economics (54%) has gone through the *Law and Economics* profile at the high school level. The Federal Statistical Office (FSO) suggests that about 13.6% of all men and 25.8% of all females in our sample will not continue with a university education. 49.7% of all students in our sample are expected to apply for a university education other than economics. Only 31.6% of all high school students (40.3% of all males, respectively 19.7% of all females) within the law and economics profile will later on major in economic sciences.[13] This supports the commonly held view that the *Law and Economics* profile is a one-size fits all program for students with no particular skills or ambitions in other domains.

III. Predictions

Our study measures the impact of different instructional treatments on the understanding of the economics of common pool resources and on social preferences. Hypotheses 1-3 make predictions with regards to the CPR test score while hypothesis 4 summarizes expectations about a treatment-induced shift in social and political preferences.

The first prediction is seemingly trivial and suggests that teaching improves economic understanding.[14] More specifically, we expect that any teaching related to CPR has a positive impact on the understanding of CPR problems.

Hypothesis 1 *Participants in the Control group perform worse in the evaluation than those in the two teaching treatments.*

We now focus on the comparison of the two teaching treatments. Existing literature suggests that, on the whole, economics classroom experiments are more effective than conventional teaching. We argue along the same lines, expecting that the participatory element of classroom experiments increases individual awareness and creates clarification for otherwise abstract economic mechanisms. Furthermore, classroom experiments are simply fun and hence stimulate students' willingness to learn. However, existing studies exclusively cover university education (mostly introductory principles courses). With our focus on high school students we are able to concentrate on the effectiveness of different teaching methods on a less selective sample (see

[12] The set of alternative compulsory choice subjects usually includes various topics from the social and natural sciences, additional languages, sports or arts.

[13] All data is from the 2008 high school cohort. Data received upon request.

[14] Some skeptics might argue otherwise. See, for example, Edwin E. Slosson cited in Miller (1927, p. 120): "Lecturing is that mysterious process by means of which the contents of the note-book of the professor are transferred through the instrument of the fountain pen to the note-book of the student without passing through the mind of either." Given that teachers freely opted-in into our experimental study, such pessimistic views are highly unlikely.

section II.4.) in an educational context in which interactive teaching methods are more common than in university lectures.

Hypothesis 2 *Participants in the Experiment treatment perform—on average—better than those in the Standard treatment.*

Comparing average performances, however, is not enough as there is evidence for different types of individuals being affected differently by each of our teaching methods.[15] Specifically, contradicting results were found for students' aptitude. On the one hand, Emerson and Taylor (2004) find that students with higher grade point averages benefit more from lecture-oriented lessons while the experimental approach is equally effective for all students. To the contrary, Dickie (2006) concludes that classroom experiments confer greater benefits on abler students.

We expect our evidence to fall in line with the latter. Holding teaching time fixed across treatments imposes a trade-of when choosing the most suitable teaching method. If the Experiment treatment crowds out time for adequately discussing the subject, less able students (i.e. those with relatively poor economic understanding) might fail to generate a profound understanding. Such a view is consistent with recent findings by Lavy (2011) who studies primary and middle school student achievements. In particular, he finds that practices aimed at the recalling of previously learned information benefit lower skilled individuals considerably (opposite to the instillment of applicative, analytical, and critical skills which seem to benefit abler students).[16]

Hypothesis 3 *Instructional benefits increase with a student's aptitude for economics. This increase is particular strong with classroom experiments.*

With their strong emphasis on free-riding incentives and externalities, both of our teaching interventions might cause learning effects strong enough to alter students' behavior and political views in related domains. Instruction on CPR problems helps students to disclose similar mechanisms in our set of incentivized economic decisions and makes them more sensitive with respect to market failures. Moreover, a first-hand observation of cooperation failure in the classroom experiment can induce conditionally cooperative people to reduce contributions.[17]

Hypothesis 4 *Students in both treatment groups hold more cautious political views on laissez-faire economics than those in the Control group. Students in the Experiment treatment make more selfish choices than those in the Standard and Control treatments.*

[15] Emerson and Taylor (2007), for example, look at how students with different Myers-Briggs personality types perform under a traditional and an experimental approach. Their results suggest that experiments do benefit, or are at least neutral with respect to, many personality types. Only 2 out of 16 personality types do better in lecture-oriented lessons. Durham et al. (2007) observe that students with different learning styles also benefit differently from classroom experiments. In particular, multimodal and kinesthetic learners, who together account for over 85% of all of their students, significantly improved performance with the use of experiments in comparison to traditional lecture-style teaching.

[16] A plausible counter-argument would be to assume that the concrete nature of classroom experiments will make it easier for low ability type students to grasp an understanding of the matter which they would not have when being confronted with rather abstract theory. However, in comparison to tertiary education the level of complexity is arguably reduced when high school students are involved.

[17] Frey and Meier (2003) as well as Falk and Zehnder (2007) show the prevalence of this type of people in Switzerland.

IV. Data

42 classes participated in our study—14 in the Control group, 15 in the Standard treatment, and 13 in the Experiment treatment.[18] The average class consists of about 18 students yielding a total of 720 individual observations. Table IV.1 provides a brief overview of the variation in data on the class and school level across control and treatment groups. Table IV.3 gives similar information on individual characteristics of students. The prevalence of missingness is within the range of what can be expected from a field study and does not show treatment-specific particularities. We refer to Table A.5 in the appendix for an overview of all variables containing missing values.

Table IV.1 – Class & school level characteristics

Variables	Control	Standard	Experiment
Class size	17.86 (4.5)	15.53 (5)	18.23 (2.49)
Teacher's perceived class motivation [1,5]	3.5 (.76)	3.47 (.74)	3.54 (1.05)
Teacher's perceived class coherence [1,5]	3.64 (.74)	3.47 (.74)	3.85 (.9)
Economics as a school subject [no. of semesters]	2.93 (2.06)	4.27 (2.43)	4.54 (2.26)
Number of classes	14	15	13
Number of teachers	13	15	12
Number of schools	13	14	13
Share of schools situated in communities >100k	.5 (.52)	.27 (.46)	.31 (.48)

Notes: Mean values per treatment. Standard deviation in parentheses. Values in square brackets indicate the range of the indices. The [1,5] index reads *low (1)*, *rather low (2)*, *average (3)*, *rather high (4)*, *high (5)*. Based on the Kruskal-Wallis equality-of-populations rank test, it cannot be rejected that all data is drawn from the same population. The number of teachers is given per treatment. Due to eight teachers participating with multiple classes, this number does not sum up to the 31 teachers that participated in total.

The subjective account of teachers regarding the overall learning environment—measured as the perceived class motivation and willingness to learn as well as class coherence—is rather positive and highly comparable between groups. The average class had been taught about three to four semesters of *Economics*, with the Control group having the least experience of all.[19] Our main interest here, however, is in the composition of the economic background of classes as performance not only depends on teaching treatments but also on knowledge acquired prior to our intervention. For that reason, we profiled classes into areas that are considered of immediate relevance to mastering the CPR test (see Table IV.2).[20] Looking at *Common-pool Resources* and its closely related field of *Public Goods*, students in both the Control and the Standard

[18] The slightly uneven allocation into groups is due to a cancellation by one class.

[19] Our sample deals exclusively with a specific type of upper secondary schools (Kantonsschule/Gymnasium). A regular student attends such a school for between six to eight semesters.

[20] The classification of which areas are considered beneficial is somewhat arbitrary, but out of necessity. Data is collected by teacher feedback and hence we are not able to capture specifics of what their students have been taught. However, our results are robust to various forms of (reasonable) classifications.

Table IV.2 – Economic background

Subject Areas	Control	Standard	Experiment
Related subjects	1.79	2.8	2.08
	(2.36)	(2.46)	(2.25)
Common-pool Resources [0-2]	.21	.2	.08
	(.43)	(.41)	(.28)
Public Goods [0-2]	.5	.8	.54
	(.65)	(.77)	(.66)
Externalities [0-2]	.5	.8	.77
	(.76)	(.77)	(.83)
Market Failure [0-2]	.57	1	.69
	(.76)	(.93)	(.85)
Other subjects	3.07	3.4	4.15
	(2.7)	(2.85)	(2.82)
Government Failures [0-2]	.5	.67	.62
	(.76)	(.82)	(.87)
Benefits of Trade [0-2]	.36	.53	.46
	(.74)	(.74)	(.66)
Role of Price Mechanism [0-2]	.79	.93	1.31
	(.8)	(.8)	(.85)
Demand & Supply [0-2]	1.07	.93	1.38
	(.83)	(.88)	(.77)
Consumer & Producer Surplus [0-2]	.36	.33	.38
	(.63)	(.62)	(.65)
Aggregate experience	4.86	6.2	6.23
	(4.5)	(4.83)	(4.87)

Notes: Mean values per treatment. Standard deviation in parentheses. Values in square brackets indicate the range of the indices. The [0-2] index represents a three-step categorization measuring the degree of familiarness of a class with the respective topic, with *no knowledge (0)*, *some knowledge (1)* or *deepened knowledge (2)*. Based on the Kruskal-Wallis equality-of-populations rank test, it cannot be rejected that all data is drawn from the same population.

group are moderately better prepared to solve CPR-related questions while the Standard group also holds an advantage in the domain of *Public Goods*. Nonetheless, teaching activities in these areas are quantitatively close to insignificant, indicating that these topics are not focal in today's curriculum. Similarly, experience in other related areas—i.e. market failures and externalities—is rather low, although the same has to be said for some typical fields of economic theory too, such as consumer and producer surplus or benefits of trade. Only core aspects of economic theory like the role of the price mechanism and the workings of demand and supply are established across all participating classes. This is not surprising given that Economics on the upper secondary level in Switzerland generally comprises business administration, accounting, and law, too. Moreover the curriculum differs substantially across cantons and occasionally even within cantons. Our data suggest that students' mindset is only mildly affected by preceding exposure to economic theory and its school of thought. One relatively persistent pattern, however, emerges in that the Control group bears the least distinctive profile in economics. This is unfortunate given our assignment procedure is fully randomized. However, statistical tests cannot reject that classes are drawn from the same population for all of the above items individually, or in the form of cumulative scores. These results also hold when both treatment groups are pooled.

Table IV.3 – Student characteristics

Variables	Control	Standard	Experiment
Share of females	.47	.49	.45
	(.5)	(.5)	(.5)
Age **	17.92	17.94	17.75
	(1.55)	(1.13)	(1.74)
Share of native-language German **	.79	.87	.86
	(.41)	(.33)	(.35)
Share of foreign-born students	.11	.08	.09
	(.31)	(.27)	(.29)
Disposable money, in CHF/month	329.38	315.23	300.21
	(342.04)	(241.11)	(253.83)
Number of books at place of residence ***	523.76	561.76	388.97
	(863.34)	(970.28)	(848.47)
Interest in economics [1,4] *	2.85	2.98	2.98
	(.73)	(.72)	(.72)
Grade in Math [1-6] ***	4.4	4.52	4.62
	(.82)	(.72)	(.79)
Grade in German [1-6]	4.71	4.72	4.68
	(.55)	(.49)	(.59)
Parents' highest level of education completed, in % **			
Primary or lower secondary (ISCED 1 & 2)	2.45	0.94	1.02
	(15.50)	(9.69)	(10.08)
Upper secondary education (ISCED 3 & 4)	32.35	50	43.88
	(46.90)	(50.12)	(49.75)
Tertiary education (ISCED 5 & 6)	65.2	49.06	55.1
	(47.75)	(50.11)	(49.87)
Number of students	250	233	237

Notes: Mean values per treatment. Standard deviation in parentheses. Values in square brackets indicate the range of the indices. The highest index value is attributed with the best or most pronounced potential outcome. Education of parents is coded according to the *International Standard Classification of Education (ISCED)*. Stars indicate the level of significance for a Kruskal-Wallis equality-of-populations rank test (ordered data) or a chi-squared test (categorical data). * Significant at 10%; ** significant at 5%; *** significant at 1%.

Variation in individual data is considerably less balanced. We observe, for example, significant differences in students' age profiles or the share of students whose native-language is German. In addition, the number of books at the place of residence as well as school grades in mathematics differ strongly between groups.[21] We also find that parents' educational background varies. The same holds for self-reported interest in economics but we cannot rule out spillover effects from both treatments here. By aggregating individual data on the class level and comparing these values across groups, we effectively control for inadvertent selection effects in the recruiting procedure, for example in the form of some classes having to operate in more demanding environments with high shares of lowly educated parents or students with migration backgrounds. Although there is variation in these data too, statistical tests cannot reject the

[21] Note that school grades are bound to curricula that are specified at the state-level and subject to teachers' preferences, which weakens their significance as an objective measure of a student's absolute level of competence.

null that all observations are drawn form the same population.

V. Results

In a first step we evaluate individual learning achievements of students on the basis of CPR test scores. We provide descriptive results followed by an econometric analysis. We then take a look at what teachers said regarding our teaching interventions and how they allocated time between tasks as well as between treatments. In a last segment, we observe individual behavior in incentivized economic decisions and study students' political opinions.

V.1. Performance in CPR test

Table V.1 reports CPR-related test results.[22] Absent any treatment intervention, 58% of all statements were solved correctly while roughly 30% were answered falsely. Hence, the Control group managed to achieve about 28% of the theoretical maximum score (4.7 score points out of 17). Students of both treatment groups fare much better, yielding average scores of 50.49% (8.58 points) in the Standard and 50.41% (8.57 points) in the Experiment treatment. Evidently, both teaching interventions were able to increase economic understanding considerably (Wilcoxon rank-sum tests, treatments vs. Control group: $p < 0.001$). Results between the Standard and the Experiment group are remarkably similar (Wilcoxon rank-sum test, Standard vs. Experiment: $p = 0.5941$), leading us to reject hypothesis 2 but not hypothesis 1.

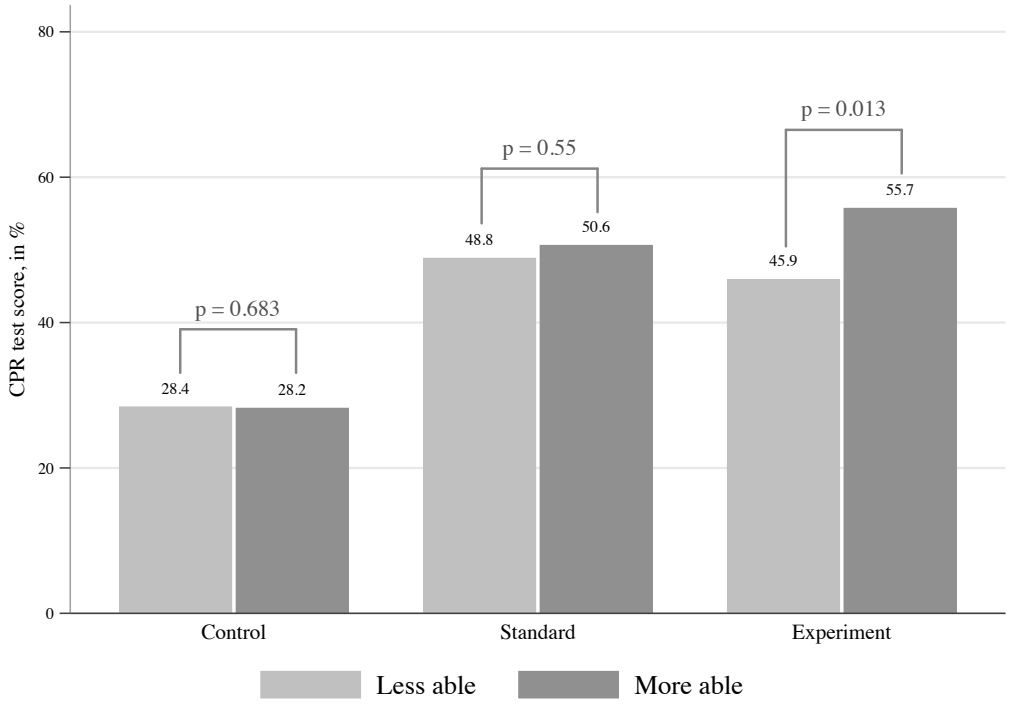
Table V.1 – Performance

	Control	Standard	Experiment
CPR test score, in % ***	27.67	50.49	50.41
	(25.44)	(23.44)	(25.22)
*Correctly answered, in % ****	58.05	70.84	71.13
	(14.27)	(13.72)	(15.41)
*Falsely answered, in % ****	30.38	20.35	20.72
	(13.56)	(11.89)	(11.49)
*Undecided, in % ****	11.58	8.81	8.14
	(11.29)	(10.46)	(10.16)
CPR test score (class level), in % ***	28.02	49.91	50.65
	(9.19)	(10.5)	(10.86)
GE test score (class mean) ***	6.81	7.69	7.43
	(.71)	(2.09)	(1.41)
GE test score (class-mean centered)	0	0	0
	(3.43)	(3.01)	(3.3)

Notes: Mean values per treatment. Standard deviation in parentheses. CPR test score: Stars indicate the level of significance for a two-sample Wilcoxon rank-sum (Mann-Whitney) test. Samples are grouped as Control vs. both treatments combined. The same test does not reject the null hypothesis when testing the Standard against the Experiment treatment. GE test score: Stars indicate the level of significance for a Kruskal-Wallis equality-of-populations rank test. * Significant at 10%; ** significant at 5%; *** significant at 1%.

[22] Results on the class level (where randomization took place) are largely comparable with student level data (where we tested economic understanding) which is why we limit our discussion to the latter. Additional data is provided upon request.

In order to show that student ability affects learning outcomes, we first have to identify a valid measure. Since school grades are bound to curricula that are specified at the state-level and subject to teachers' preferences, their significance as an objective measure of student competence is severely weakened. Thus, our ability measure is constructed on the grounds of our test on general-economic understanding (GE test score). This test assesses the level of economic understanding in a standardized way across classes, making it the most precise measure available. Not addressing the problem of class-level confounding, however, would lead to misinterpretations of our results. We therefore create an instrument variable for the test score that is uncorrelated with the level of economic knowledge in a class. In order to obtain our desired measure, we first generate class-mean scores and then subtract these from individual test scores. The former then gives between-class information while the latter takes up within-class information, which allows to make valid statements on students ability relative to their peers. Figure 1 shows evidence that indeed students with a GE test score equal or above their class average (high ability) do better in the CPR test than students below the class average (low ability), in particular in the Experiment treatment (Wilcoxon matched-pairs signed-rank test, $p = 0.013$). This result is apparently in line with hypothesis 3.



Notes: Mean values of classes per treatment and ability. Ability is an instrument variable based on the GE test score. Students with a GE test score equal or above their class average are classified as "more able". Test statistics are for Wilcoxon matched-pairs signed-rank tests between more and less able students per class.

FIGURE 1 – STUDENT ABILITY

A purely descriptive analysis, however, fails to account for variations in individual and class-

level characteristics across treatments. Controlling for these will make treatment estimates more precise, most notably in terms of knowledge acquired prior to our intervention. Moreover, our data exhibits a distinct multilevel structure. Achievements of students and classes are, for example, likely to be clustered on the teacher-level due to the influence of idiosyncratic characteristics on teachers quality.[23] In order to account for these peculiarities in our data, we apply the three-level random-intercept model

$$score_{ijk} = \gamma_0 + intervention_{jk}\gamma_1 + experiment_{jk}\gamma_2 + \boldsymbol{x'_{ijk}}\boldsymbol{\beta} + \xi_k + \zeta_{jk} + \epsilon_{ijk} \qquad (1)$$

where $score_{ijk}$ is the achieved percentage score in the CPR test for $i = 1, ..., 720$ students nested in $j = 1, ..., 42$ classes, nested in $k = 1, ..., 31$ teachers.[24] γ_0 marks the constant. The indicator variable $intervention_{jk}$ equals one if a class received any sort of treatment and zero otherwise. Similarly, $experiment_{jk}$ indicates classes that took part in the Experiment treatment. As a result, γ_1 captures a general learning effect that is common to both teaching interventions while γ_2 is an estimate of the additional effect of the Experiment over the Standard treatment. The fixed part of the model is completed with $\boldsymbol{x'_{ijk}}$, the vector of auxiliary variables, and the fixed regression coefficients $\boldsymbol{\beta}$. The random part of the model comprises the level-1 residual ϵ_{ijk}, the level-2 random intercept ζ_{jk} of classes, and the level-3 random intercept ξ_k of teachers.[25] Following standard regression assumptions, the level-1 residual is assumed $\epsilon_{ijk} \sim [0, \sigma^2_\epsilon]$. It is further assumed that random effects at each level have a multivariate normal distribution and at different levels are mutually independent and independent of the level-1 residual.

Our baseline specification replicates the descriptive account in a simple difference-in-means estimation. This specification is augmented by a cumulative score variable based on the four economic background items we consider most beneficial for mastering our test (see Table IV.2). We subsequently enhance the baseline model with our measure for individual ability.[26] Since we expect both interaction effects for our economic background measure as well as individual ability, we subsequently interact both variables with our treatment dummies. Our last specification includes an extensive set of auxiliary controls such as urban/rural distinctions, class size, school grades or disposable money.[27] We address the issue of data missingness by relying on multiple imputation techniques, which is regarded as the current state of the art approach in the relevant

[23] Many observable teacher characteristics such as teaching certification and years of teaching experience are not highly correlated with teacher quality (Hanushek, 2002). It has been shown a number of times, however, that teacher quality is essential in explaining student performance (see, e.g. Kane and Staiger, 2008; Aaronson et al., 2007; Rivkin et al., 2005; Rockoff, 2004).

[24] Economists have traditionally preferred the implementation of fixed effects mostly due to the less demanding model assumptions. In our case, however, the treatment intervention occurred on the class level, which is making it impossible to model class fixed effects as these do not permit estimation of the coefficients of class-invariant estimators. Similarly, we must not rely on teacher or school fixed effects. Such an interference would reduce statistical power considerably since we frequently observe cases with only one single treatment intervention per school. We also reject a pooled cross-section model approach as it is unrealistic to assume that students' performance within the same class or under the same teacher is independent given the observed covariates.

[25] Adding a second random effect on top of class-level random effects is supported by a likelihood-ratio test. Adding a third random effect—either for schools or for cantons—does not increase the model fit.

[26] Our ability measure is an instrumental variable for the GE test score that is uncorrelated with the random intercept ζ_{jk}. Statistical tests strongly prefer this approach over including the cluster-mean centered covariate only. For details see Skrondal and Rabe-Hesketh (2004).

[27] The full set of controls can be found in Table A.2 of the appendix.

methodological literature (Graham, 2009; Schafer and Graham, 2002).[28] All standard errors are clustered on the highest level. We provide non-clustered results in the appendix.

While Table V.2 reveals strong positive effects for both teaching interventions and in that sense reaffirms the purely descriptive results from above. Results further suggest that classes' economic background in CPR-related areas as well their performance in the GE test have significant explanatory power. Yet it is not only class-mean performance that predicts success in the CPR test but also a student's relative performance in comparison to her peers.

Table V.2 – CPR Learning

Dep. var.: CPR test score, in %	(1)	(2)	(3)	(4)
Teaching intervention	18.40***	17.35***	18.16***	17.63***
	(3.740)	(2.608)	(2.714)	(2.388)
Experiment	2.969	3.682	1.987	2.686
	(2.410)	(2.586)	(1.999)	(2.192)
Economic background		2.020***		1.106*
		(0.456)		(0.575)
GE test score (class-mean centered)			1.201***	1.201***
			(0.316)	(0.316)
GE test score (class mean)			3.556***	2.576***
			(0.617)	(0.784)
Constant	31.08***	26.66***	30.61***	28.33***
	(2.718)	(2.141)	(2.151)	(2.102)
Auxiliary controls	*no*	*no*	*no*	*no*
Number of teachers	31	31	31	31
Number of students	720	720	720	720

Notes: 3-level random effects model. Random effects for teachers and classes. Maximum likelihood estimation. Standard errors clustered on teachers. Constant represents students with average characteristics. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table V.3 largely reproduces above estimations but extends their informative power by introducing interaction terms. Specification 1 reveals that a distinct profile in CPR-related areas is most beneficial to those who were not exposed to any teaching intervention. For both the Standard and the Experiment treatment these effects are indistinguishable from zero. Of particular importance is a strong effect of student ability on test scores presented in specification 2. In the Experiment treatment, with a value of 2.05 the aggregate size of the estimate is more than double of that in the Control or Standard group and in that significantly different from both of them individually (at 5% level). The effect of ability (i.e. the General Economics test score) is also in itself significant for the Experiment (at 1% level) while it is not for both other groups.[29] A standard deviation change in the ability measure affects the test score by 6.76%.

[28] Note that unlike other imputation routines, multiple imputation explicitly accounts for the uncertainty associated with the missing data. Multiple imputation also holds a clear advantage over ad hoc techniques such as listwise deletion (complete-case analysis) or pairwise deletion (available-case analysis). These traditional techniques require MCAR data and can produce distorted parameter estimates when this assumption does not hold. Another advantage of multiple imputation is that it avoids large scale sample size attrition. In our situation, a complete-case regression analysis would be particular wasteful since a sample size reduction of 157 observations considerably reduces statistical power. Our working data set consists of 20 imputations. We double-checked model robustness by relying on both imputation using multivariate normal regression and imputation using chained equations (sequential regression imputation). In our analysis, the choice of the procedure does not have any meaningful effect on the interpretation of our treatment effects. Results rely on imputed data using chained equations for reasons of greater flexibility. Imputation generates more conservative results compared to a complete-case analysis in the light of our research question.

[29] The latter finding is most likely due to a small sample size on the class level. P-values are relatively close

The result implies that classroom experiments (at the high school level) favor more able students, while weaker students are actually worse off than they would be under a regime that depends on conventional teaching. Our next two specifications combine both interactions while they differ in the controls used (see Table A.2 for details). Our key estimates appear robust to changes in model specifications, giving us confidence that reported results are strong. Most auxiliary controls are insignificant, but their estimates point to a meaningful direction. With respect to educational policies our data supports the view that the ability to comprehend test questions is essential. Receiving good school grades in German helps to significantly improve test scores. An increase of one standard deviation raises the test score about 3%.[30] Another aspect worth pointing out is a student's socialization and her place of birth. Only including a dummy for foreign-born students reveals a significant estimate. Complementing this with information on speaking the German language as the mother tongue makes the birth-place dummy become insignificant.[31] The estimate on the mother tongue is highly significant and with an effect size of 8.4% also economically relevant. Since we control for school grades in German, the dummy on a student's mother tongue rather captures socialization effects than German language skills. A matter of ongoing debate is also wether students in smaller classes gain more from teaching.[32] We report that the size of a class has absolutely no predictive power. Last, take notice that we observe no gender effects, and that all of the applied control variables do not show any interactions with one of our treatment conditions.

Concluding this section, we still must not reject hypothesis 1. And while there is a steady tendency for the Experiment group to outperform the Standard group after taking into account the nested structure of our data, hypothesis 2 is still rejected throughout all specifications. However, there is evidence in line with hypothesis 3. Experimental learning increases the gap between more able and less able students. Since the effect of CPR-related teaching prior to our intervention is indistinguishable between both treatments and, if anything, less relevant for participants in the Experiment group, we infer that experimental learning is more demanding for some subjects, which is why there appears to be a widening rift in test scores with respect to economic capabilities of a student.

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to the 10% level.

[30] An increase of one standard deviation equates to a shift from the sample mean of 4.7 to 5.24, roughly corresponding to a move from B- to B+ for the US grading scale. However note the caveat that (self-reported) school grades in German are not an ideal measure for objective language skills.

[31] Students are regarded native German-speaking if they either speak one of the many Swiss or Austrian dialects, or standard German.

[32] Typically, a lower class size was attributed with higher student achievements and still is considered as a key school improvement policy in many countries. However, more recent findings indicate that this is not unanimously the case. Hoxby (2000), for example, finds no such effects when relying on population variation in the US. Moreover, she illustrates nicely why Krueger (1999) might find rather strong effects in his influential evaluation of the Tennessee Student/Teacher Achievement Ratio experiment ("Project Star"). Wößmann and West (2006) further show that in any such discussion a country's school system is of utmost importance. In particular, smaller classes seem to have a beneficial effect on student achievement only in countries where the average capability of the teaching force appears to be low. This certainly does not apply to the school system in Switzerland. Unfortunately, data for Switzerland, Germany and Austria is absent from their evaluation for statistical reasons.

Table V.3 – CPR Learning, with interactions

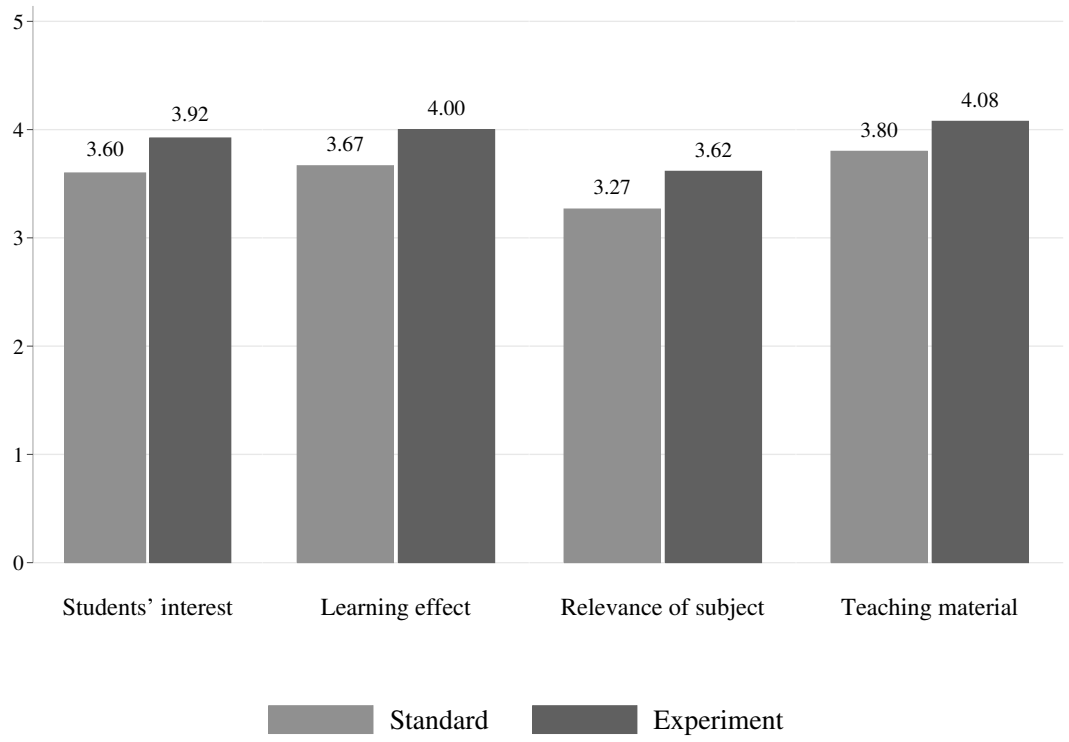
Dependent variable: CPR test score, in %	(1)	(2)	(3)	(4)
Teaching intervention	20.73***	17.63***	20.70***	20.89***
	(2.482)	(2.389)	(2.480)	(2.513)
Experiment	3.859	2.689	3.887	3.550
	(2.640)	(2.192)	(2.642)	(2.640)
Economic background	2.461***	1.106*	2.464***	2.402***
	(0.824)	(0.575)	(0.827)	(0.681)
Teaching intervention	−1.969**		−1.966**	−2.713***
× Economic background	(0.831)		(0.832)	(0.794)
Experiment	−0.720		−0.727	−0.350
× Economic background	(1.440)		(1.439)	(1.373)
GE test score (class mean)	2.936***	2.576***	2.928***	3.147***
	(0.729)	(0.784)	(0.730)	(0.776)
GE test score (class-mean centered)	1.201***	0.726	0.726	0.399
	(0.316)	(0.541)	(0.541)	(0.569)
Teaching intervention		0.0975	0.0975	0.0889
× GE test score (class-mean centered)		(0.757)	(0.757)	(0.748)
Experiment		1.228**	1.228**	1.156*
× GE test score (class-mean centered)		(0.618)	(0.618)	(0.603)
Constant	26.76***	28.33***	26.77***	30.36***
	(1.948)	(2.101)	(1.948)	(2.932)
Auxiliary controls	*no*	*no*	*no*	*yes*
Number of teachers	31	31	31	31
Number of students	720	720	720	720

Notes: 3-level random effects model. Random effects for teachers and classes. Maximum likelihood estimation. Standard errors clustered on teachers. Constant represents students with average characteristics. * Significant at 10%; ** significant at 5%; *** significant at 1%.

V.2. Teachers' Perspective

Individual feedback from teachers is in line with the learning effects found on the student level. Figure 2 summarizes their reception based on a series of questionnaire items. Most importantly, teachers were asked to rate their students' interest in the treatment lesson as well as perceived learning effects, represented by a scale from *low (1)* to *high (5)*. Although their assessments do not differ statistically between the Standard and the Experiment treatment, with an excess margin of about 10% results are in favor of the latter throughout. In absolute terms, teachers view both teaching methods to have triggered above-average responses in interest and learning behavior, albeit both are not expected to perform drastically better than a typical lesson in Economics. In addition, we can look at a subset of five teachers (11 classes) who took part in both treatments.[33] Perceived interest drops from 3.6 to 3.2 for the Standard treatment while it remains relatively stable for the Experiment treatment with only a slight drop from 3.92 to 3.83. Similarly, perceived learning effects fall from 3.67 to 3.4 in the Standard treatment while they remain at 4 in the case of the experiment. Thus in direct comparison, the experimental teaching method performs favorably. Last, we also find weak evidence for positive spill-over effects from the Experiment treatment on how teachers regard the relevance of CPR problems. Appreciation towards a given subject matter is arguably of fundamental importance to a teacher's motivation. Yet again, these difference are not statistically significant.

[33]The sequence of events is evenly distributed between teachers doing the Standard treatment first, followed by the Experiment treatment, or the other way round.



Notes: Mean values per treatment. The [1,5] index reads *low (1)*, *rather low (2)*, *average (3)*, *rather high (4)*, *high (5)*. Wilcoxon rank-sum tests reveal no significant differences in the distribution of the two treatments.

Figure 2 – Teaching Methods in Comparison

A more detailed look on the Experiment treatment is offered in Table V.4, where teachers were asked to assess the quality of the experimental teaching module in four key areas. These are the persuasiveness of the didactical concept, the comprehensibility of all rules and procedures of the game, the overall quality of the game, and the overall quality of the teaching module. We conclude that this teaching module is scoring distinctly high marks in every aspect. Importantly, rules and procedures were very clear to them, as seen in an almost perfect score and relatively low variance. For that reason, we can feel confident that we are actually measuring what we aim to measure.

All in all, feedback from participating teachers exhibits that they were highly satisfied with both teaching treatments while at the same time the Experiment treatment tends to score better than the more traditional approach to teaching. Furthermore, asking who will reuse the teaching module also in other classes, all but one teacher from the Standard group agreed. While these results underpin the quality of the learning platform of the Swiss National Bank, it also supports our claim that we test classroom experiments in a particularly conservative setting.

In order to reach a valid conclusion on the superiority of one over the other treatment, we also have to look at the effort put into the preparation of a respective lesson. Table V.5 summarizes preparation times across treatments and provides information for the time spent on specific tasks. Preparation time for the classroom experiment is roughly 8.6% below the

Table V.4 – Review of Experimental Teaching Module

Variables	Experiment
Persuasiveness of didactical concept [1,5]	4.23 (.73)
Comprehensibility of rules and procedures of game [1,4]	3.85 (.38)
Overall quality of game [1,5]	4.69 (.48)
Overall quality of module [1,5]	4.31 (.63)

Notes: Mean values per treatment. Standard deviation in parentheses. Mean values correspond to unique teacher feedback, that is teachers participating in one treatment with multiple classes are counted only once. Values in square brackets indicate the range of the indices. The [1,5] index reads *low (1)*, *rather low (2)*, *average (3)*, *rather high (4)*, *high (5)*. The [1,4] index reads *low/do not agree (1)*, *rather low/do not agree (2)*, *rather high/do agree (3)*, *high/do agree (4)*.

corresponding value for the Standard treatment. A closer look at our data shows that about 20% (31%) of all teachers from the Standard (Experiment) treatment spend between 30 and 60 minutes, 33% (38%) between 1 and 2 hours, and 47% (31%) between 2 and 3 hours on preparation. Given the novelty of classroom experiments as a teaching tool and its rather expansive set of teaching material, this might seem surprising. It remains unclear whether this means that preparation intensity was increased in the Standard case out of necessity as teachers needed to provide complementary material for the lesson themselves, or whether we observe a variation of an experimenter demand effect where teachers tried to make their own lesson as good as possible in order to shine. There is also reason to believe that teachers participating in both treatments might have some advantage in preparing for the second treatment. However, we do not find conclusive evidence in that regard. Five teachers were participating in both treatments. Excluding them results in an average preparation time of 127.5 minutes for the Standard treatment (10 observations) and 102.86 minutes for the Experiment treatment (7 observations). One of the five teachers was engaged with four classes and carried out the experiment twice. He reduced preparation time for the experiment considerably, from 2-3 hours down to 1/2-1 hour. Looking at the other four teachers reveals no tendency. The sequence of events is evenly distributed between teachers doing the Standard treatment first, followed by the Experiment treatment, or the other way round. Preparation time is highly comparable between treatments, regardless of the sequence, but with about 73 minutes clearly below the average preparation time in general. We argue that this is not an issue of spillovers but self-selection of more able teachers into participating with multiple classes. In any case, mean preparation time is comparable between treatments and potentially lower for the Experiment group.

A more detailed look at how time was spent on different tasks during the two-lesson (90 minutes fixed) treatment interventions reveals that on average individuals from the Experiment group had less time at hand to complete both mandatory tasks, that is reading a summary text that recapitulates key features of CPR problems as well as how these problems can be addressed effectively, and working on corresponding paper and pencil exercises and discussing the results.

Table V.5 – Time allocation between treatments

Variables	Standard	Experiment
Preparing the lesson	109	94.62
	(42.98)	(43.03)
Reading theoretical summary text **	17.08	11.09
	(7.15)	(4.7)
Solving mandatory exercises *	25.83	19.11
	(6.69)	(6.09)
Playing the game	–	44.79
		(17.66)

Notes: Average time in minutes. Standard deviation in parentheses. Stars indicate the level of significance for a Kolmogorov-Smirnov equality-of-distributions test. * Significant at 10%; ** significant at 5%; *** significant at 1%.

The significantly lower figures are most likely due to a tighter time schedule for the Experiment group.[34] This interpretation is supported by the fact that in both treatments two classes did not read the summary text during the lesson. In addition, three classes of the Standard treatment respectively four of the Experiment treatment did not finish the mandatory exercises in class.

V.3. Behavior and Opinions

We start with the review of individual behavior in a series of well-established incentivized economic decisions (see Table V.6). Among these decisions, the one-shot public good game mimics the incentive structure of CPR problems most closely. At first glance, these results suggests that hypothesis 4 must not be rejected. A Cuzick trend test finds a strong tendency to lower contributions from the Control over the Standard to the Experiment group (p=0.004). A similar tendency is found for adjustments in beliefs (p=0.024). Further in line with our hypothesis is the fact that the share of participants that did not answer the control questions correctly is steadily decreasing over all treatments. Focusing the analysis on a reduced sample, however, reveals that neither a participant's belief nor her actual contribution behavior is significantly trending (p=0.264 and p=0.135) given she understood the mechanism of the game correctly.[35] We conclude that noise from students not understanding the game artificially increased the significance level in our data. A slight tendency for lower contributions in the Experiment group is likely due to participation in the similarly composed CPR fishing game. Absent any institutional regularization that restricts (to a certain extent) the possibility to free-ride, these students know from first-hand experience that they have not been able to maintain a sustainable fishing quota

[34] Running a two-sample Kolmogorov–Smirnov test of the equality of distributions gives us p=0.039 for the summary text and p=0.078, for the exercise part.

[35] Very similar results are found when relying on a Kruskal-Wallis equality-of-populations rank test. Test statistics for contributions change from 0.0127 to 0.2659, those for anticipated contributions from 0.0398 to 0.4075. Furthermore, addressing the same questions in a regression design using class-level random effects shows that contribution levels are highly similar between both treatment groups when controls are correctly solved, and statistically indistinguishable from the Control group (p>0.5). The same is true for what is believed that others will contribute. Last, for the sake of clarity we also abstain from showing descriptive statistics on the class level. Also here, both Kruskal-Wallis and Cuzick trend tests generally indicate no significant differences, with the exception of the share of correctly solved controls (p=0.067). All of these analyses are provided upon request.

Table V.6 – Summary statistics

Public Goods game	Control	Standard	Experiment
Contribution to Public Good [0,3] ***/ ◇◇	1.8	1.73	1.53
	(1.07)	(1.05)	(1.03)
Contribution to Public Good [0,3], if correct only	1.75	1.65	1.58
	(1.07)	(1.05)	(1.02)
Anticipated contribution to Public Good [0,3] **/ ◇◇	1.71	1.7	1.55
	(.8)	(.72)	(.74)
Anticipated contribution to Public Good [0,3], if correct only	1.66	1.65	1.57
	(.82)	(.69)	(.74)
Share of falsely answered control questions [0,1] **/ ◇◇	.36	.32	.25
	(.48)	(.47)	(.43)
Remaining games	Control	Standard	Experiment
Dictator game, contribution [0,9]	2.92	2.74	2.64
	(2.56)	(2.27)	(1.92)
Envy game, contribution [0,9]	7.62	7.73	7.19
	(2.24)	(2.3)	(2.74)
Ultimatum game, offer [0,9]	4.29	4.16	3.94
	(1.72)	(1.45)	(1.37)
Ultimatum game, rejection threshold [0,10]	1.88	1.92	1.97
	(1.87)	(1.77)	(1.64)
Trust game, give away [0,9]	3.91	3.96	3.8
	(3.02)	(3.07)	(3)
Trust game, return-to-receive ratio [0,1]	.24	.23	.22
	(.19)	(.13)	(.12)

Notes: Mean values per treatment. Standard deviation in parentheses. Stars indicate the level of significance for a Cuzick trend test. Diamonds indicate the level of significance for a Kruskal-Wallis equality-of-populations rank test. */ ◇ Significant at 10%; **/ ◇◇ significant at 5%; ***/ ◇◇◇ significant at 1%.

in the classroom experiment.[36] However, the same students are more likely to understand the design of a public good game. While this effect is partly mediated through factual knowledge acquisition as seen in the difference between the Control and the Standard group, it also indicates that gains from actually having experienced such a situation has helped in comprehending the workings of a similar decision framework.

Taking into account the behavior in other incentivized decisions strengthens our conclusion further. Again, contributions in the Experiment group are lowest throughout all other games but differences between treatments are far from being significant. Both in the dictator and the envy game, this might be seen as an additional sign for a deteriorated attitude towards others. It is, however, not the case for the ultimatum game, where the interpretation of contribution levels as a measure for pro-social behavior is generally less advisable due to the games' strategic nature. Last, also behavior in the trust game is statistically indistinguishable between groups. Neither do students trust less nor do they return fewer coins after having participated in the classroom experiment. We conclude that none of the treatment interventions changed the way our students act in incentivized decisions. Whether slightly lower contributions in the Experiment group are actually caused by our one-time teaching intervention or rather constitute an artifact of the

[36] However, classes did on average increase the number of rounds played from the first to the second trial substantially (Wilcoxon matched-pairs signed-ranks test: $p < 0.01$). Table A.4 in the appendix summarizes.

sampling process, would best be addressed in a longitudinal study of similar scope. With the current design we are not able to make any stronger statements.

Turning our attention to how students provided information on political survey questions again supports our current findings (see Table V.7). Only two out of seven political views differ noticeably between groups. However, both are not related to knowledge of CPR goods. There is only one question that relates directly to that matter: how to best regulate fish catch. Yet even though we observe lower marks for laissez-faire policies in both treatment groups, these effects are too small to be statistically significant.[37] Still, an overwhelming majority of all students already believes that some sort of governmental intervention is needed to regulate fish catch, and a traditional approach with a comprehensive set of rules for market participants is generally favored over a marked-based approach based on tradable fishing rights. Quite generally, our students appear sensitized to an ecologically compatible life style. A large majority would like to see the government subsidizing investments into carbon emission reduction. The home country bias, however, is strong as almost halve of these students do not consider that investments abroad reveal a higher marginal return. Students are also sympathetic of carbon-neutral air travels (with the revenue appropriated for the protection of the environment, only) but support is quantitatively rather weak.

In sum, hypothesis 4 is rejected. Both behavior and preferences appear unaffected by our one-time treatment interventions. Preferences slightly differ in some areas but these do not relate to our field experiment.

VI. Conclusion

This paper provides evidence on the impact of classroom experiments on economic understanding. Contrary to existing literature, which investigates university students exclusively, our focus lies with high school students. The pervasive opinion that experimental learning is altogether a more effective teaching practice could not be confirmed. Results from our field experiment suggest that classroom experiments do not offer a significant benefit over conventional teaching methods, as overall test scores were remarkably similar in both treatment groups. There are, however, several potential explanations for this divergence. First, economic education at universities is generally more abstract than at high schools. Reliance on case studies, newspaper articles or movie segments in our conventional teaching treatment encourages this view. Also, conventional instruction on the tertiary level is often teacher-centered ("chalk and talk") while, commonly, teaching at high schools emphasizes discussions between a teacher and her students more strongly. As a consequence, the additional value of the participatory element is less salient

[37] Opinions might be confounded by running the test questions first. Students from the Control group might have acquired knowledge from participation in the test. However, the fact that these students show even less uncertainty in this question than those from the Experiment group, casts doubt on the magnitude of such an effect. If students from the Control group ex-ante believed more strongly in laissez-faire policies but test questions sparked some mistrust, then one should observe increased uncertainty with respect to the proper solution to the problem in comparison to both teaching interventions.

Table V.7 – Political Opinions

Variables	Control	Standard	Experiment
International trade is affected by customs duty such as tariffs. (in %)			
High tariffs harm the domestic economy	44.8	47.0	47.4
High tariffs benefit the domestic economy	22.4	26.3	27.4
I do not know	32.8	26.7	25.2
Best governmental strategy to regulate fish catch? (in %)			
Do nothing: markets determine reasonable amount of fishing	2.4	0.9	0.4
Government action: tradable fishing rights	26.1	33.1	26.8
Government action: comprehensive set of regulations	64.7	62.2	65.5
I do not know	6.8	3.9	7.2
Subsidize domestic companies for their investments into carbon emission reduction? (in %)			
No, such subsidies are not necessary	5.6	11.6	8.1
Yes, for investments carried out in the domestic country only	43.2	50.6	44.1
Yes, regardless of the recipient countries of the investments	42.8	33.5	37.3
I do not know	8.4	4.3	10.6
Adopt carbon-neutral air travels [-2,2]	.28	.33	.33
	(1.1)	(1.06)	(1.03)
Reduce agricultural subsidies [-2,2] *	.22	.47	.23
	(1.79)	(1.66)	(1.67)
Strengthen role of government in health care [-2,2] **	−.18	0	.01
	(.96)	(1.02)	(.98)
Welfare state has grown too large [-2,2]	−.14	−.01	−.31
	(1.56)	(1.59)	(1.54)

Notes: Mean values per treatment. Standard deviation in parentheses (if applicable). Values in square brackets indicate the range of the indices. The [-2,2] index reads *do not favor (-2)*, *rather do not favor (-1)*, *do not know (0)*, *rather do favor (1)*, *do favor (2)*. Stars indicate the level of significance for a Kruskal-Wallis equality-of-populations rank test. * Significant at 10%; ** significant at 5%; *** significant at 1%.

on the high school level.[38] Still, students in the Experiment treatment seem to abstract more easily from what they have learned, leading to a significantly better understanding of public good games. This confirms the need for an integrated study of learning effects as it has been pointed out by, for example, Seidel and Shavelson (2007).

In addition, low-ability students and females have been at a disadvantage in economics classes, historically. Some evidence has been found that experimental instruction benefits females (Emerson and Taylor, 2004; Ball et al., 2006). We could not replicate those findings. Our Experiment treatment, however, increased the dispersion in measured learning by offering greater benefit to abler students while harming weaker students. This result is consistent with Dickie (2006) but it runs counter to that of Emerson and Taylor (2004).[39] We suspect that the time used for different tasks partly explains low performance. This goes well with more recent findings. Our classroom experiment does not require more preparation time than conventional instruction, but it crowds out time spent on reiterating knowledge and working on related issues. In Lavy (2011), both of these teaching elements are associated with conventional teaching, which he finds to benefit less able students more. Similarly, Schwerdt and Wuppermann (2011) accentuate the importance of time as a limiting factor in effective teaching practices. In rather general fashion, they argue against a reduction of traditional lecture style teaching (opposite to teaching

[38] At the same time, our results lend support to the educational methodology at (Swiss) high schools, too.
[39] Note that some studies also find no interaction effect. See, e.g., Ball et al. (2006).

based on problem solving), based on information on in-class time use from the 2003 wave of the Trends in International Math and Science Study (TIMSS). Furthermore, participating teachers view both traditional and experimental instruction as beneficial in both motivational and learning domains, but assess the classroom experiment better throughout. This might lead to a more frequent application of experiments in high schools. Not knowing that less able students need additional guidance when conducting experiments, however, would stimulate unwanted divergence in class performance.

Studying eventual side effects of our treatment interventions on both political opinions and behavior revealed no coherent pattern. With the inclusion of incentivized economic decisions we made a first systematic inquiry into the study of indoctrination at the high school level. Although no effects were statistically significant, the slight downward trend in contributions warrants further investigation. For these reasons we encourage a more extensive study of experimental teaching at educational levels other than universities. In particular, we call for long term randomized controlled trials covering multiple semesters. These would allow for the most proper evaluation. Even though such studies demand substantial resources and coordination efforts of all parties involved, they make for the most transparent approach to isolate consequences of different teaching practices.

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Appendix A

Table A.1 – CPR Learning (not clustered)

Dep. var.: CPR test score, in %	(1)	(2)	(3)	(4)
Teaching intervention	18.40***	17.35***	18.16***	17.63***
	(3.229)	(2.951)	(2.951)	(2.853)
Experiment	2.969	3.682	1.987	2.686
	(3.007)	(2.760)	(2.841)	(2.739)
Economic background		2.020***		1.106*
		(0.559)		(0.619)
GE test score (class-mean centered)			1.201***	1.201***
			(0.264)	(0.264)
GE test score (class mean)			3.556***	2.576***
			(0.782)	(0.907)
Constant	31.08***	26.66***	30.61***	28.33***
	(2.507)	(2.461)	(2.100)	(2.459)
Number of teachers	31	31	31	31
Number of students	720	720	720	720

Notes: 3-level random effects model. Random effects for teachers and classes. Maximum likelihood estimation. Standard errors not clustered. Constant represents students with average characteristics. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table A.2 – CPR Learning, with interactions

Dep. var.: CPR test score, in %	(1)	(2)	(3)	(4)
Teaching intervention	20.73***	17.63***	20.70***	20.89***
	(2.482)	(2.389)	(2.480)	(2.513)
Experiment	3.859	2.689	3.887	3.550
	(2.640)	(2.192)	(2.642)	(2.640)
Economic background	2.461***	1.106*	2.464***	2.402***
	(0.824)	(0.575)	(0.827)	(0.681)
Teaching intervention	−1.969**		−1.966**	−2.713***
× Economic background	(0.831)		(0.832)	(0.794)
Experiment	−0.720		−0.727	−0.350
× Economic background	(1.440)		(1.439)	(1.373)
GE test score (class mean)	2.936***	2.576***	2.928***	3.147***
	(0.729)	(0.784)	(0.730)	(0.776)
GE test score (class-mean centered)	1.201***	0.726	0.726	0.399
	(0.316)	(0.541)	(0.541)	(0.569)
Teaching intervention		0.0975	0.0975	0.0889
× GE test score (class-mean centered)		(0.757)	(0.757)	(0.748)
Experiment		1.228**	1.228**	1.156*
× GE test score (class-mean centered)		(0.618)	(0.618)	(0.603)
Female				−1.379
				(1.760)
Foreign-born				−3.160
				(2.807)
Grade in German				5.279***
				(1.925)
Grade in mathematics				0.807
				(0.998)
Disposable money, in CHF/month (in logs)				0.920
				(0.860)
No. of books at place of residence (in logs)				2.124***
				(0.655)
Parents' highest education completed: ISCED 1 & 2				7.170
				(7.297)
Parents' highest education completed: ISCED 5 & 6				0.542
				(2.053)
School is situated in a city (>100k)				−2.815
				(2.504)
Class size				0.0456
				(0.298)
No. of semesters in Economics				0.973**
				(0.432)
Non-German-speaking				−8.376***
				(2.379)
Age (class mean)				−0.0311
				(0.847)
Age (class-mean centered)				−2.912***
				(0.952)
Constant	26.76***	28.33***	26.77***	30.36***
	(1.948)	(2.101)	(1.948)	(2.932)
Number of teachers	31	31	31	31
Number of students	720	720	720	720

Notes: 3-level random effects model. Random effects for teachers and classes. Maximum likelihood estimation. Standard errors clustered on teachers. Constant represents students with average characteristics. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table A.3 – CPR Learning (not clustered), with interactions

Dep. var.: CPR test score, in %	(1)	(2)	(3)	(4)
Teaching intervention	20.73***	17.63***	20.70***	20.89***
	(3.699)	(2.853)	(3.694)	(3.531)
Experiment	3.859	2.689	3.887	3.550
	(3.768)	(2.739)	(3.761)	(3.795)
Economic background	2.461***	1.106*	2.464***	2.402***
	(0.830)	(0.619)	(0.829)	(0.804)
Teaching intervention	−1.969		−1.966	−2.713**
× Economic background	(1.215)		(1.214)	(1.171)
Experiment	−0.720		−0.727	−0.350
× Economic background	(1.176)		(1.174)	(1.128)
GE test score (class-mean centered)	1.201***	0.726*	0.726*	0.399
	(0.264)	(0.424)	(0.424)	(0.414)
GE test score (class mean)	2.936***	2.576***	2.928***	3.147***
	(0.898)	(0.907)	(0.897)	(0.845)
Teaching intervention		0.0975	0.0975	0.0889
× GE test score (class-mean centered)		(0.656)	(0.656)	(0.636)
Experiment		1.228*	1.228*	1.156*
× GE test score (class-mean centered)		(0.675)	(0.675)	(0.654)
Female				−1.379
				(1.817)
Foreign-born				−3.160
				(3.043)
Grade in German				5.279***
				(1.659)
Grade in mathematics				0.807
				(1.134)
Disposable money, in CHF/month (in logs)				0.920
				(0.782)
No. of books at place of residence (in logs)				2.124***
				(0.725)
Parents' highest education completed: ISCED 1 & 2				7.170
				(8.188)
Parents' highest education completed: ISCED 5 & 6				0.542
				(2.055)
School is situated in a city (>100k)				−2.815
				(2.520)
Class size				0.0456
				(0.250)
No. of semesters in Economics				0.973
				(0.595)
Non-German-speaking				−8.376***
				(2.607)
Age (class mean)				−0.0311
				(0.878)
Age (class-mean centered)				−2.912***
				(1.064)
Constant	26.76***	28.33***	26.77***	30.36***
	(2.456)	(2.459)	(2.454)	(3.097)
Number of teachers	31	31	31	31
Number of students	720	720	720	720

Notes: 3-level random effects model. Random effects for teachers and classes. Maximum likelihood estimation. Standard errors not clustered. Constant represents students with average characteristics. * Significant at 10%; ** significant at 5%; *** significant at 1%.

Table A.4 – Outcome of classroom experiment

Variables	First run	Second run
Class played standard situation	13/13	7/11
Class played variant with opportunity to punish	0/13	4/11
Class played variant with class conference	0/13	0/13
Game lasted full 10 rounds	0/13	3/11
Game ended prematurely in overfishing	11/13	6/11
Game was halted by teacher	2/13	2/11
Number of rounds played	4.55 (1.81)	6.64 (2.62)

Notes: Two classes did not play a second round and were therefore excluded from the calculation of the number of rounds played. With 9 respectively 7 rounds completed, however, these classes scored first and third in the first run. All but three classes were able to increase the number of rounds played in the second trial. Only one of those experiment lasted one round less compared to the first trial while the other two showed no change in the number of rounds played. A Wilcoxon matched-pairs signed-ranks test (adjusted for small sample sizes) strongly rejects that both distributions are the same with $p<0.01$.

Table A.5 – Missing Data

Response variables	Missing	Complete
Contribution, in *Public Good* game	6	714
Belief, in *Public Good* game	6	714
Contribution, in *Dictator* game	2	718
Contribution, in *Envy* game	4	716
Contribution, in *Ultimatum* game	1	366
Contribution, in *Trust* game	1	359
Return, in *Trust* game	14	361
Opinion on agriculture subsidy	1	719
Opinion on carbon policy	2	718
Opinion on overfishing	3	717
Opinion on subsidizing ecofriendly investments	1	719
Opinion on health care system	1	719
Opinion on free trade	4	716
Opinion on welfare state	1	719
Explanatory variables	**Missing**	**Complete**
Females	4	716
Age	13	707
Mother-tongue	6	714
Working student	11	709
Disposable money	51	669
Number of books at place of residence	20	700
Newspaper consumption	8	712
Wellbeing in current class	8	712
Number of brothers and sisters	9	711
Parents living in same household	10	710
Grade in Math	13	707
Grade in German	15	705
Parents' highest level of education completed	108	612

Appendix B

Instructions and Questionnaires

Students

Below we provide translated versions of the instructions, the test, and the questionnaire for students first. Students received all material simultaneously. The test was collected after the 12 minutes time limit had expired. All material was collected after every student had finished his/her questionnaire. Note that the ultimatum game and the trust game require a partner. Questionnaires were handed out in four variations differing from each other with respect to students being the first or second mover in the ultimatum game and the trust game, respectively (first/first, first/second, second/first, and second/second). Students were randomly matched with a partner of a complementary questionnaire. Questionnaires were given out in randomized order. The below questionnaire presents the case for students being assigned to first movers throughout.

Teachers

We also provide instructions and questionnaires for teachers. The first part of any questionnaire is common to both treatments and the control group. Treatment-specific questions differ, yet questions for the Standard treatment represent a subset of those in the Experiment treatment, which is why they are not presented separately.

Coupon
exaple_code—XYZ

Instructions

Dear students,

You will participate in a scientific study. First, you will answer various questions of economic understanding. You have 12 minutes to complete these questions. After completion, you are allowed to continue with the survey section that you have received separately.

The survey is divided into tree segments. Segment one allows you to participate in situations where your decision affects both your and your class members' pay. In segment two, you will be asked to express you political view on a variety of topics. Segment three asks you to answer question related to you personal background.

Participation allows you to make money. We will evaluate your answers within a couple of days and pay out the total of both the economic understanding and the survey section together. You are kindly requested to separate the green ticket in the top right corner from this sheet of paper. This ticket is marked with a unique code that allows us to match you and your answers in a way that guaranties a fully anonymous transaction. Keep this ticket save until you have received your money. Details on how your answers affect your pay are given in the respective sections.

Note that your answers will be processed under strict confidentiality and for scientific purposes only. Data is fully anonymous and will not be passed to any third party such as your teacher or your parents.

Please do answer all questions onyx our own. Questions do vary between surveys. If you need any further assistance, please refer to one of our staff.

We would like to thank you for your participation in advance.

Economic Understanding

You are about to answer multiple-choice questions on various topics of economic understanding. Please indicate whether you perceive an answer to be correct or false.

Every correctly answered question will gain you an additional 20 cents. Every false answer will result in an equivalent deduction in payment. Example: You perceive the statement to be false and mark it accordingly. However, the statement is actually true. Hence, 20 cents are deducted from your account.

You are also allowed to mark the "I do not know" checkbox. In that case, you will neither gain nor lose money from this particular statement. Leaving blank any of the three checkboxes will be counted as an "I do not know" answer as well.

Should you happen to answer more statements falsely that correctly, your pay will be zero. It is not possible to lose money.

You have 12 minutes to answer the following questions.

Situation 1

For some animals living in the wild, the following conditions are true: Humans cannot be hindered to make use of these animals (e.g. hunting). Each individual making use of these animals (e.g. hunting) will by his action decrease other humans' benefit given they are pursuing similar interests.

One example for the above situation is whales in the sea. What are the consequences of such a situation? Note that every statement is true only if the given justification is also true.

	true	**false**	**don't know**
a) Animals such as whales are often hunted down excessively due to the self-interest of the proprietor.			
b) Animals such as whales are often hunted down excessively due to the lack of a proprietor who is able to pursue his property rights against the interest of others.			
c) Animals such as whales are often hunted down excessively due to the irrational behavior of hunters and the lack of foresight regarding the consequences of their actions.			
d) The likelihood of hunting down such animals excessively increases with the size of the group of hunters. Anonymity between hunters further stimulates this mechanism.			
e) Animals such as whales will not be hunted down excessively if hunters know that these animals are close to being extinct.			

Situation 2

Four peasants let their cattle browse on the same pasture. This pasture belongs to the community. Sadly, every peasant lets to many of his cows browse on the common pasture so that it cannot recover in due time. The community recognizes the problem and is wiling to help. Which of the following propositions will most likely lead to the end of the overexploitation of the pasture?

	true	**false**	**don't know**
a) The community pays an additional 5'000 Swiss francs a year to each of the peasants.			
b) The community divides the pasture into four parcels of land and sells these parcels to the peasants.			
c) The community sets up a letter that explains the problem to the peasants. The letter reminds them that they let too many cattle browse on the pasture.			
d) The community auctions the exclusive right of use of the pasture. The highest bid wins the right.			
e) The community buys additional land so that the common pasture increases fourfold. Usage of the pasture is still free to all four peasants.			

Situation 3

There are 30 guests residing in a mountain lodge. Using the shower is free of charge. An average guest wants to use the shower for about 5 minutes. 10 guests want to shower 10 or more minutes. Warm water supply lasts for 4 minutes per guest only. Which of the following statements is true?

	true	**false**	**don't know**
a) If all guests are informed that the water supply is limited to 4 minutes per guest, then an overuse of warm water does usually not occur.			
b) An overuse of warm water is less likely when all of the 30 guests are friends. Social norms help achieving this.			
c) It is sensible to limit the usage of the shower to 4 minutes per guest.			
d) It is not sensible to ask for a price for warm water, as it is not possible to specify the benefit from using warm water for each of the 30 guests separately.			

Situation 4

Three independent and democratic countries are situated around a big lake. All three countries engage in the agricultural business to a large extent and compete with lots of other countries on the world market. The three countries rely heavily on the water supply from the above lake in order to produce their agricultural goods. The lake, however, is close to running dry. For that reason, the governments of the three countries meet. They agree upon reducing water usage from the lake in the magnitude of 50% within the next 5 years. Each country is free to chose how it achieves this reduction individually.

	true	**false**	**don't know**
a) As we are speaking of democratic countries, it is usually the case that their commitment will be achieved successfully.			
b) Whether the conference means a success remains to be seen. These countries are assumed to be fully independent, and hence there is no court at a higher level that can sanction unsuccessful countries.			
c) Whether the conference means a success remains to be seen. None of the participating countries has any incentive to unilaterally weaken its agricultural business while others stay put.			

Situation 5

Assume that the price for gasoline has risen sharply. What kinds of consequences are to be expected in the short (a few days or weeks) or medium term (a few months)?

	true	**false**	**don't know**
a) Consumers will buy less gasoline.			
b) Prices for cars running on fossil fuel will increase.			
c) Prices for cars running on fissile fuel will decrease.			
d) Prices for electric cars will fall.			

Situation 6

Assume a merchant and a customer agreeing to trade a banana for a given sum of money. Who will profit from this bargaining process?

	true	false	don't know
a) Usually, it is only the seller who does benefit from this trade.			
b) It is usually both the seller and the buyer who benefit from such a trade.			
c) None of the two parties usually benefits from such a trade. Both are as well off as they were before the trade.			
d) The seller benefits and the buyer loses out on the trade, or vice versa.			

Situation 7

Assume that the local authorities introduce a new maximum rent for all residences. This maximum rent lies clearly below the current average rent. It is common knowledge that there was neither a surplus nor a deficit of flats to rent prior to the intervention. Answer below statements considering only long-term effects of the intervention.

	true	false	don't know
a) Neither a surplus nor a deficit of flats to rent should be expected.			
b) There will be more flats than there are people willing to rent. An excess in flats to rent is a likely result.			

Situation 8

Sugar is bought and sold daily on an international commodity market. Who is responsible for the market price of a pound of sugar?

	true	false	don't know
a) Only the buyer willing to pay the highest price.			
b) Only the seller willing to sell for the lowest price.			
c) All the buyers and sellers together determine the market price for sugar.			

1. Economic decisions

In the following you will be able to make money based on the decisions you make. Your decision has a direct impact on the amount of money you will get out of this segment. Income is calculated in points where

1 point equals 30 cents.

In some of the cases, it is not only your decision that affects your payment but also the decision of other members of the class. Similarly, your decision-making can have an effect on the payment of other class members. Whenever you are interacting with a class member, he or she is matched with you purely by chance. Neither you nor the respective class member will be able to infer the identity of the other. Importantly, whenever you are faced with a decision affecting others

you are interacting with a member of the class only once.

As it has been stated before. You will receive the amount of money within a couple of days following a strictly confidential procedure. It will not be possible for others to know how much money you made.

Decision 1

You as well as every other member of the class are endowed with 3 points at the outset. Each of you decides independently to keep this initial endowment or transfer all or parts of it into a public cash box. The points total in the cash box will be doubled and back-transferred in equal shares to each of you, regardless of your initial contribution.

Hence, your income from this decision comprises:

- *The points you decided not to transfer into the public cash box, and*
- *an equal share of the doubled sum transferred from all class members into the public cash box*

Example: There are 20 students in a class. Their initial endowment is 3. Each of them transfers exactly 0 points into the public cash box. As there are no points in the cash box, no points can be doubled. Hence, students do not receive any income from the public cash box. As each of the students has kept his or her initial endowment, their final income is 3.

Derive the final income in the following example:

There are 20 students in a class. Their initial endowment is 3. One half of the class transfers 0 while the other halve transfers 3 points into the public cash box. All points transferred are doubled yielding a total of 60 in the public cash box. As in the example above, each student gets an equal share out of the total sum in the cash box.

What is the final income of a student who has transferred exactly 0 into the public cash box? Enter your answer in the box to the right (number).	
What is the final income of a student who has transferred exactly 3 into the public cash box? Enter your answer in the box to the right (number).	

You are in the same situation as above. How do you decide with respect to your own class?

How many points do you transfer into the public cash box? Enter your answer in the box to the right (number).	
How many points of your endowment remain with you? Enter your answer in the box to the right (number).	
How many points will your average classmate transfer into the public cash box? What do you expect? Enter your answer in the box to the right (number).	

Decision 2

Your income from this decision is 4,50 points. Check the respective box below in order to determine the points granted to a randomly selected member of the class. You are allowed to transfer between 0 and 9 points.

Indicate your decision by checking the respective box:

Your income	4,50	4,50	4,50	4,50	4,50	4,50	4,50	4,50	4,50	4,50
Other student	9, –	8, –	7, –	6, –	5, –	4, –	3, –	2, –	1, –	0, –
Your decision										

Please, check one box, only!

Decision 3

You are endowed with 9 points. It is up to you how you want to split these points between you and another member of the class. This student is selected randomly. Either your choice or that of the other class member is actually carried out. This again is determined randomly.

Indicate your decision by checking the respective box:

You keep	0, –	1, –	2, –	3, –	4, –	5, –	6, –	7, –	8, –	9, –
Other student receives	9, –	8, –	7, –	6, –	5, –	4, –	3, –	2, –	1, –	0, –
Your decision										

Please, check one box, only!

Decision 4

You are again endowed with 9 points, and it is still up to you how you want to split these points between you and another member of the class.

However, the student you are interacting with has the right to refuse any of the below distributions. If he happens to reject your offer, both you and the other student receive 0 points. If he happens to accept your offer, then points are transferred to each of your accounts accordingly. The student you are interacting with is determined randomly.

Indicate your decision by checking the respective box:

You keep	0, –	1, –	2, –	3, –	4, –	5, –	6, –	7, –	8, –	9, –
Other student receives	9, –	8, –	7, –	6, –	5, –	4, –	3, –	2, –	1, –	0, –
Your decision										

Please, check one box, only!

Decision 5

You are endowed with 9 points. It is up to you how you want to split these points between you and another member of the class. The points transferred to the other student are now tripled.

The other student is free to decide how many of his points he will transfer back to you. However, back-transferred points are not tripled. Again, the class member you are interacting with is chosen randomly.

Example: You are endowed with 9 points and decide to transfer 2 points to the other student. These 2 points are tripled, resulting in 6 points total for the other students. You now have 7 points left (9 minus 2). The other student decides to back-transfer 1 point to your account. His final income is then 5 (6 minus 1) while your final income is 8 (7 plus 1).

Derive the final income in the following example:

You are endowed with 9 points and transfer 5 to the other student. These 5 points are tripled, yielding 15 points in total. The other student decides to back-transfer 2 points to your account.

What is your final income? Enter your answer in the box to the right (number).	
What is the final income of the other student? Enter your answer in the box to the right (number).	

You are in the same situation as above. How do you decide yourself?

You keep	0, –	1, –	2, –	3, –	4, –	5, –	6, –	7, –	8, –	9, –
You transfer	9, –	8, –	7, –	6, –	5, –	4, –	3, –	2, –	1, –	0, –
Other student receives	27, –	24, –	21, –	18, –	15, –	12, –	9, –	6, –	3, –	0, –
Your decision										

Please, check one box, only!

2: Political View

We present you a list of political statements. Please indicate our opinion by marking the respective checkbox. Opinions are subjective. There is no correct or false answer. As always, full confidentiality applies.

Should there be mandatory surcharges on airline tickets that are defined by the amount of carbon emission per flight? The revenue gained would be spent on the protection of the environment only.	□ Yes. □ Rather yes. □ Rather no. □ No. □ I do not know.
Should there be a reduction in governmental subsidies for the agricultural businesses?	□ Yes. □ Rather yes. □ Rather no. □ No. □ I do not know.
The government regulates medical insurance companies. Would you like to see an increase in its influence on these health insurances?	□ Yes. □ Rather yes. □ Rather no. □ No. □ I do not know.
Should domestic companies receive subsidies for investments into carbon emission reduction?	□ Yes, for investments carried out in the domestic country only. □ Yes, regardless of the recipient countries of the investments. □ No, such subsidies are not necessary. □ I do not know.

International trade is, beside others things, affected by customs duty such as tariffs. What is your opinion?	□ High tariffs harm the domestic economy. □ High tariffs benefit the domestic economy. □ I do not know.
Has the welfare state in Switzerland grown too large?	□ Yes. □ Rather yes. □ Rather no. □ No. □ I do not know.
Which of the following statements is according to your opinion the best governmental strategy to regulate fish catch?	□ Do nothing. The market will determine a reasonable amount of fishing. □ The government should introduce limiting fishing rights, which can be traded via markets. □ The government should define an individual maximum quantity for fishing as well as where exactly a fisher is allowed to cast for fish. □ I do not know.

3: Personal Information

We would like to know more about your personal background. Information you provide is treated with strict confidentiality and will not be passed to any third party. Please answer truthfully.

- What is your sex?

  ☐ Male ☐ Female ☐ Other

- What is your date of birth? (dd/mm/yyyy)

  ……..

- What is your country of birth?

  ……..

- Is your mother tongue German?

  ☐ Yes ☐ No

- Please provide the grades from your last school certificate for the following subjects:

Subject	Mathematics	German	French	Sports	Economics
Grade					

- Where is your current place of residence? (Name + ZIP)

  ……..

- Do your parents live in separate households?

  ☐ Yes ☐ No

- What is your parents' highest level of education completed?

  ☐ Primary or lower secondary education (compulsory education)

  ☐ Upper secondary or post-secondary non-tertiary education
  (e.g. vocational education, higher vocational education, general qualification for university entrance)

  ☐ Tertiary education
  (e.g. university, university of applied sciences)

  ☐ I do not know

- A bookshelf holds on average 40 books. Please give an estimate on the total number of books at your place of residence. (Number)

  ……..

- How many times do you on average read the newspapers a weak?

Never	1 - 2	2 - 3	3 - 4	4 - 5	5 - 6	6 - 7	> 7

- What is your general interest in topics revolving around economics?

  ☐ Not interested ☐ Rather not interested

  ☐ Very interested ☐ Rather interested

- How many brothers and sisters do you have? (Number)

  ……..

- How happy are you in your current class?
  (1 = very unhappy, 10 = very happy)

1	2	3	4	5	6	7	8	9	10

- Do you engage in the field of voluntary work?

  ☐ yes, often ☐ yes, occasionally ☐ no

- Do you earn money besides going to school?

  ☐ yes ☐ no

- How much pocket money do you get a month? (Average number)

  ……..

- How much money do you have available each month, taking together your pocket money, job earnings, and other sources of income. (Average number)

  ……..

We value your opinion. You are encouraged to give us feedback on how you liked this questionnaire. In particular, indicate what was unclear to you and where you see scope for improvements.

……
……
……
……
……..

Instructions

Control Group

We would like to thank you for your participation in our field experiment. Your effort will contribute to the understanding of students' learning behavior and improve the offerings of «iconomix.ch», the learning platform maintained by the Swiss National Bank.

You were randomly chosen not to participate in any teaching treatment. This means that you will not have to prepare any lesson prior to the day of the evaluation.

Please note the questionnaire attached. We advise you to fill in the questionnaire and hand it over to our staff the day the evaluation takes place.

We would like to thank you again for your participation. Do not hesitate to contact our staff for further assistance by email or phone. Mr. Pascal Sulser, pascal.sulser@snb.ch, +41446313926.

Instructions

Standard Treatment

We would like to thank you for your participation in our field experiment. Your effort will contribute to the understanding of students' learning behavior and improve the offerings of «iconomix.ch», the learning platform maintained by the Swiss National Bank.

You were randomly chosen to carry out a lesson on common-pool resources (CPR) problems. In order to achieve a certain degree of comparability between teachers conducting the same treatment, you are kindly requested to follow the below instructions.

Please also note the two questionnaires attached. We advise you to fill in the questionnaire on class properties before conducting the lesson. The second questionnaire revolves around your impressions on the treatment lesson and the material provided. Your feedback will help to further improve the learning experience. We encourage you to give critical feedback.

1. Preparation

i. Familiarize yourself with all the material provided. This is arguably the most time consuming part of your preparation.

ii. You have received the following documents by email:

«Overhead Transparencies» including a list of «Key Events», «Worksheets» including a sample solution, and the «Summary» text.

2. Conducting the treatment lesson (2x45 minutes)

Hold a lesson on CPR problems (scheduled time is 45 minutes)

i. Prepare a lesson on CPR problems to your liking. You are free to chose your didactic approach. We strongly encourage you not to use any classroom experiment for this lesson.

ii. You have received an overhead transparency on the decline of fish population in the Atlantic Ocean and a list of related key events in chronological order. Use this slide as an introductory example into the topic. Extend your lesson with additional resources to your liking.

iii. We suggest you discuss the following questions in particular

- What drives the problem of overfishing?
- What behavior is rewarding from an individual perspective?
- Which properties of international fishing lead to overfishing?

iv. What you need in class:

- Overhead transparency on the decline of fish population
- List of related key events

Deepen students' understanding: CPR and the tragedy of the commons

i. Translate the insights gained into a more general understanding for CPR goods and the tragedy of the commons. Have a look at the summary text beforehand. There you'll find lots of real-life examples and ideas to broaden students' understanding.

ii. Refer to the key characteristics of CPR goods. Also explain key technical terms such as «negative externalities» and explicitly look at strategies that help to prevent the overuse of CPR goods.

iii. What you need in class:

- Overhead transparency on solutions to the tragedy of the commons
- Optional: summary text

Self-study session for students

i. Instruct students to work trough the exercises on their own. Discuss the exercises in class afterwards. If there was not enough time to carry out the exercises in class, we encourage you to give homework.

ii. Instruct students to read the summary text on their own. If there was not enough time to read the summary text in class, we encourage you to give homework.

iii. What you need in class:

- Worksheets (one copy per student)
- Summary text (one copy per student)
- Optional: Sample solution to the exercises

3. Follow-up

i. Invite your students to ask questions during the next lesson with regards to the exercises and the summary text, in case there was not enough time to complete one or both in class.

ii. Please complete the questionnaire and hand it over to our staff the day the evaluation takes place.

We would like to thank you again for your participation. Do not hesitate to contact our staff for further assistance by email or phone. Mr. Pascal Sulser, pascal.sulser@snb.ch, +41446313926.

Instructions

Experiment Treatment

We would like to thank you for your participation in our field experiment. Your effort will contribute to the understanding of students' learning behavior and improve the offerings of «iconomix.ch», the learning platform maintained by the Swiss National Bank.

You were randomly chosen to carry out a classroom experiment on common-pool resources (CPR) problems. In order to achieve a certain degree of comparability between teachers conducting the same treatment, you are kindly requested to follow the below instructions.

Please also note the two questionnaires attached. We advise you to fill in the questionnaire on class properties before conducting the lesson. The second questionnaire revolves around your impressions on the treatment lesson and the material provided. Your feedback will help to further improve the learning experience. We encourage you to give critical feedback.

1. Preparation

i. Familiarize yourself with all the material provided. This is arguably the most time consuming part of your preparation.

ii. In order to successfully carry out the classroom experiment, it is required to have appropriate masks. You can order a set of masks by sending a request to contact@iconomix.ch.

iii. You have received the following documents by email:

«Commentary for teachers», «Game instructions», «Overhead Transparencies», «Worksheets» including a sample solution, and the «Summary» text.

2. Conducting the treatment lesson (2x45 minutes)

Play the CPR simulation game (scheduled time is 45 minutes)

i. Conduct the classroom experiment according to the instructions. Please do not give an introduction to the topic in advance. For instance: «Today, we are going to carry out an experiment. You will see for yourself what it is all about in due time.» Explain the rules of the game with the aid of the overhead transparencies.

ii. We encourage you to play a first run without the option to punish, and a second run with punishment options and/or conferences.

iii. Present the results of both runs afterwards. Discuss the outcomes in class and give a first insight into the problem of CPR as it is suggested in the instructions. It is advised to introduce students to the case of overfishing in the Atlantic ocean. See the respective overhead transparencies and the additional information attached. Also see the commentary for teachers for suggestions on which particularities of the game should be highlighted and how to give explanations.

iv. What you need in class:

- Masks
- Overhead transparencies

v. What you need for preparation:
   - Commentary for teachers
   - Game instructions

Deepen students' understanding: CPR and the tragedy of the commons

i. Translate the insights gained into a more general understanding for CPR goods and the tragedy of the commons. Have a look at the summary text beforehand. There you'll find lots of real-life examples and ideas to broaden students' understanding.

ii. Refer to the key characteristics of CPR goods. Also explain key technical terms such as «negative externalities» and explicitly look at strategies that help to prevent the overuse of CPR goods.

iii. What you need in class:
   - Overhead transparencies
   - Optional: summary text

Self-study session for students

i. Instruct students to work trough the exercises on their own. Discuss the exercises in class afterwards. If there was not enough time to carry out the exercises in class, we encourage you to give homework.

ii. Instruct students to read the summary text on their own. If there was not enough time to read the summary text in class, we encourage you to give homework.

iii. What you need in class:
   - Worksheets (one copy per student)
   - Summary text (one copy per student)
   - Optional: Sample solution to the exercises

3. Follow-up

i. Invite your students to ask questions during the next lesson with regards to the exercises and the summary text, in case there was not enough time to complete one or both in class.

ii. Please complete the questionnaire and hand it over to our staff the day the evaluation takes place.

We would like to thank you again for your participation. Do not hesitate to contact our staff for further assistance by email or phone. Mr. Pascal Sulser, pascal.sulser@snb.ch, +41446313926.

Questionnaire

School: …… Class: ……

Information on current class

A) How many semesters of economic education has this class been taught up until now?

☐ 0 – 1 ☐ 1 – 2 ☐ 2 – 3 ☐ 3 – 4

☐ 4 – 5 ☐ 5 – 6 ☐ 6 – 7 ☐ 7 – 8

B) What is your impression with regards to the overall motivation and willingness to learn?

☐ lower than avg. class ☐ rather lower than avg. class

☐ average class ☐ rather above an avg. class ☐ above an avg. class

C) What is your impression with regards to the overall coherence of this class?

☐ lower than avg. class ☐ rather lower than avg. class

☐ average class ☐ rather above an avg. class ☐ above an avg. class

D) Please indicate the educational history of this class with respect to the following topics in economics:

	not taught	only briefly	comprehensively
Conception of Demand & Supply	☐	☐	☐
Consumer & Producer Surplus	☐	☐	☐
Market Failure	☐	☐	☐
Government Failure	☐	☐	☐
Benefits of Trade	☐	☐	☐
Externalities	☐	☐	☐
Role of Prices in Market	☐	☐	☐
Public Goods	☐	☐	☐
Common Pool Resources	☐	☐	☐

Questionnaire

School: …… Class: ……

Considering the treatment lesson

A) Did you apply the teaching module on CPR problems already in the past?

☐ never ☐ once ☐ multiple times

B) Please indicate which of the following material was used in your treatment session. Also indicate the approximate time spent on the respective task.

☐ Summary text: about …… minutes

☐ Exercises: about …… minutes

C) Did you use additional material or ideas that was not part of the package you received?

☐ yes ☐ no

If your answer is yes, please explain your motivation and the procedure applied. If needed use an extra sheet of paper to summarize your approach.

……

……

If your answer is yes, how much time did you spend on developing and carrying out your approach?

☐ < ½ h ☐ ½ – 1 h ☐ 1 – 2 h ☐ 2 – 3 h ☐ > 3 h

D) How much time did you invest in preparing the treatment lesson?

☐ < ½ h ☐ ½ – 1 h ☐ 1 – 2 h ☐ 2 – 3 h ☐ 3 – 4 h ☐ > 4 h

E) Would you say that the rules and procedures were clear to your students?

☐ no ☐ rather no ☐ rather yes ☐ yes

F) How did you carry out the CPR simulation game? (Multiple answers possible)

	Standard	Punishment	Conferences
First run:	☐	☐	☐
Second run (if plaid at all):	☐	☐	☐

G) How many rounds did the experiment last?

	No. of rounds	Pond was empty	Game halted
First run:	……	☐	☐
Second run (if plaid at all):	……	☐	☐

H) All in all, how much time did it take to play the CPR simulation game? (Number)

…… minutes

I) Did the CPR simulation game trigger any emotional response in students?

☐ weak ☐ rather weak ☐ rather strong ☐ strong

How would you describe the emotions observed: ……

……

……

Do you think those emotions helped or hindered achieving the desired educational goal?

☐ hindered ☐ rather hindered ☐ rather helped ☐ helped

J) What is your impression with regards to the interest shown in the treatment lesson?

☐ low ☐ rather low ☐ average ☐ rather high ☐ high

K) What is your impression with regards to the achieved learning effect?

☐ low ☐ rather low ☐ average ☐ rather high ☐ high

L) How important is the topic of common-pool resources to you personally in comparison to other topics of economics teaching?

☐ unimportant ☐ rather unimportant ☐ rather important ☐ important ☐ very important

M) How convinced are you with regards to the didactical conception of the CPR simulation game?

☐ not convincing ☐ rather convincing ☐ very convincing

☐ rather not convincing ☐ convincing

N) Rate the overall quality of the supporting material (summary text and exercises).

☐ bad ☐ rather bad ☐ satisfactory ☐ good ☐ very good

O) Rate the overall quality of the CPR simulation game.

☐ bad ☐ rather bad ☐ satisfactory ☐ good ☐ very good

P) Rate the overall quality of all the material provided for the treatment lesson.

☐ bad ☐ rather bad ☐ satisfactory ☐ good ☐ very good

Q) Do you see yourself applying this teaching material in other classes as well?

☐ no ☐ yes ☐ yes, but excluding the CPR simulation game

☐ rather no ☐ rather yes ☐ rather yes, but excluding the CPR simulation game

R) Do you have additional remarks with respect to the treatment lesson or our field experiment?

……

……

……

……

……

……

……

Teaching Material

The full set of instructions, as well as all documents required to carry out treatment lessons are provided below. All teaching material is provided in a translated version by the Swiss National Bank, which is also accessible online at “iconomix.ch”, although information provided online is subject to change.

COMMON POOL RESOURCES

Commentary for teachers

1 Overview

1.1 Topic and contents

This module deals with common pool resources and the problem of their overuse (tragedy of the commons). Through their own actions during the course of a game, students experience at first hand the major incentives inherent in common pool resources. They discuss possible solutions as well as the difficulties involved in trying to implement them, and they look at the effect of sanctions and conferences. Concepts such as economic types of goods, the tragedy of the commons, externalities, sustainability, the scarcity of resources, the role of the state and social norms are explained. The topic can be – but does not need to be – linked to environmental problems (e.g. CO_2 emissions and global warming).

1.2 Type of iconomix module

The main element of this module is an offline strategy game that can be played in class. Access to computers is not needed. Slides and a projector are required, however.

1.3 Time required

Two to four lessons, depending on the degree of detail with which the topic is addressed.

1.4 Subjects and level of difficulty

Suitable subjects: Economics and humanities, ecology, geography, history, civic education, sociology and psychology.

Level of difficulty: Intermediate. The game can be used in a wide range of contexts. In the evaluation phase, the level of difficulty can be adjusted to the students' knowledge of the topic.

1.5 Learning objectives

The module aims to develop the following economic skills:

Personal skills

Students should be able to:

- analyse their own behaviour with respect to common pool resources.

Social skills

Students should be able to:

- discuss solutions for the tragedy of the commons with each other.

Professional skills

Students should be able to:

- name the characteristics of common pool resources (in comparison with other economic types of goods) and describe them in their own words;
- explain which incentives may lead to the tragedy of the commons;
- determine which goods or situations trigger the tragedy of the commons phenomenon;
- describe economic solutions for the tragedy of the commons using an example from real life.

1.6 Documentation

The module consists of this commentary for teachers and the following documents:

- Fishpond explained
- Slides for teachers (rules of game, check sheet, scoring system, overfishing of cod, solutions)
- Score sheet for players
- Worksheet 1
- Worksheet 2
- Knowledge sheet
- Knowledge test
- Advanced question
- Sample answers

You can order any document from this module by completing the online form at www.iconomix.ch/en/common_pool.

2 Working with the module

2.1 Overview of module phases

The teaching material is based on a three-phase concept:

1. **Learning by doing:** Offline strategy game (Fishpond)
2. **Learning through dialogue:** Discussion in class, knowledge sheet, transfer task
3. **Learning by applying:** Knowledge test

For information on the educational background, cf. 'Learning with iconomix' at www.iconomix.ch/en/learning. An overview of how to work with the module, including space for notes and individual modifications, can be found at the end of this document.

2.2 Learning by doing

In the first phase, the students play the strategy game – Fishpond – in class. Using a projector and slides, the teacher guides the students through the game. The rules of the game and the different stages of each round are described in a separate document ('Fishpond explained').

In this game, a fishpond serves as the common pool resource. In several rounds, the students anonymously try to catch as many fish (points) as possible. Each player can catch up to three fish per round. If they catch no more than two fish per round on average, the fish population can recover in a sustainable way between the rounds. This means, theoretically, that there would always be sufficient fish in the pond and the game could go on forever. However, since the players are tempted to catch three fish per round, the resource is usually overused or even depleted; an outcome which is bad for everybody. This situation clearly demonstrates the conflict between the temptation to achieve personal gain and the desire to act in the interest of the group as a whole; in other words, a classic case of the tragedy of the commons.

To make sure that decisions are taken anonymously, players should wear masks. These can be ordered at www.iconomix.ch/en/common_pool.

Over the course of the game, penalties for overuse may be introduced. This means that whoever catches three fish in any one round may receive penalty points, which are then deducted from their score. This can only happen if enough other players participate in an effort to punish them and are willing to give up one of their own points. While this may slow the depletion of the resource, the process can generally not be stopped altogether.

One particularly interesting aspect to the game is the option to call a class conference. The players get three minutes to decide on how to proceed and whether to change something about the way they are playing the game. It is theoretically possible that, after such a conference, the fish population in the pond can be sustained for the duration of the game. The outcome remains to be seen, however. Just like in real life, it is to be expected that not all players will observe the resolutions made in the conference.

Ideally, the game should first be played without the additional options (penalty points, class conference), which means that it will probably only take a few rounds. The game can then be played a second time, this time introducing the penalty option and – if the fish population continues to fall – calling a class conference. This way, the students get to experience both the depletion of the fish stocks (in the first game) and the effect of a conference (in the second game). An alternative approach would be to play just one game, introducing the penalty option after two rounds and, if necessary, calling a class conference at a later round. Although this eliminates the need to play the game twice, the students may not get to witness the fish stock depletion. It also makes it more difficult to compare the different game outcomes, i.e. with measures to counter the problem versus without.

Not all teachers can easily identify with the aim of the game. The aim of the game (to catch as many fish as possible) is distinct from the learning objective (to understand the tragedy of the commons). The game exemplifies a problem that commonly occurs in the real world. While this might call for a discussion on ethical issues, it is recommended to play the game first before doing so. Ensuring the survival of the fishpond may seem like a preferable goal, but this would only result in a tedious, dull game, which would neither spark a discussion afterwards nor reflect reality (e.g. the overfishing of the world's oceans).

Helpful hints

- To motivate the students, the teacher could set realistic goals; for instance, by awarding a small prize to all players who achieve grade 5 or above, and a more substantial prize to those who achieve grade 5.5 or above. If all the students exercise some restraint when playing and only ever take two

fish, they should theoretically all be able to achieve grade 5 and win the small prize. Without having the possibility to consult with one another, however, this can prove quite difficult in practice. In any case, the big prize is practically unobtainable if there are several players trying to win it. Furthermore, in their attempts to win it, they will render it impossible for anybody to achieve the grade required for even the small prize.

- The rules of the game should be explained very clearly – if possible with the help of a projector and the slides provided. For example, the players should all aim to catch as many fish as possible. Whether one player catches more than the others is not relevant to the outcome of the game.
- Calling a conference when the situation is critical but not beyond recovery reaps the best results and is more exciting than calling it too early.

2.3 Learning through dialogue – discussion in class

It is to be expected that the students will begin to see the problem posed by their desire to score as many points as possible. In the review phase, this issue should be identified and addressed. The teacher then asks specific questions to get the students to discuss the characteristics and effects of common pool resources that they discovered during the course of the game.

Some central questions (based on four levels of review):

- **Observations:** What happened during the game?
- **Emotions:** How did the students feel? How did they react to seeing the fishpond becoming emptier and emptier as the game progressed?
- **Explanations:** Why was the fish population in the pond depleted (or why was it not)? Which types of behaviour were rewarded? What mechanisms led to the overfishing? Why did the penalties work (or why did they not)? Why was the conference effective (or why was it not)?
- **Comparison with real life:** Can parallels to the real world be drawn?

Some possible answers:

- **Observations:** The fishpond is usually completely emptied. Penalties may slow the depletion, but the process can generally not be stopped altogether. In exceptional cases – small classes that show restraint and solidarity – the pond may not be totally emptied. If a conference is called, the outcome of the game cannot be foreseen; as, very often, a few players will not adhere to the resolutions made.
- **Emotions:** A combination of emotions can be observed – anger, glee, enjoyment or frustration (because it is obvious what will happen if the pond is overfished; but some players do not care about the consequences and continue fishing). These emotions can arouse the students' interest and help them to better understand how the system works.
- **Explanations:** As the game progresses, it will become clear to everyone that they should all be restricting their catch to two fish per round so that the fish population can renew itself indefinitely. On an individual level, however, the act of taking three fish is rewarded, which leads to the depletion of the pond's fish stocks. This phenomenon is the result of two characteristics of common pool resources. Firstly, nobody can be excluded from consumption (everyone is entitled to take three fish). Secondly, rivalry exists between the consumers (whoever overfishes, reduces the stock for everyone). The fact that the players fish anonymously makes the situation all the more complicated. Penalties can act as a deterrent and may help slow the outcome (overfishing). However, those who do not participate in the penalty process also benefit from the exercise (referred to as free riding). It is therefore difficult to get sufficient players to participate. While conferences can be effective, it is not easy to implement the resolutions made. One of the most effective resolutions that can be made is to abolish the anonymity rule.
- **Comparison with real life:** The teacher can draw a parallel with the real-life example of cod fishing in public waters (using the slide provided), where the outcome was very similar to what generally happens in the game. Global warming and a great many other environmental problems – although not all – are also comparable to the fishpond. Conferences are held regularly to address issues relating to the protection of the environment or endangered species; and the difficulties in achieving binding resolutions are well known.

Theory

Students can read the knowledge sheet either in class or at home. Alternatively, the teacher can tell them the most important points. The knowledge sheet summarises the key aspects and terminology relating to common pool resources.

Transfer task

As an alternative to worksheet 1 – particularly for more advanced classes – worksheet 2 can be assigned as an exercise. Using specific examples of problems in connection

with common pool resources, the students look at causes and possible solutions. For this purpose, the teacher can display the slide with possible solutions on the projector or distribute the document among the students. Answers may be discussed or reviewed in class. Alternatively, the class (or teacher) can use the internet or other media to obtain information about a conference on overfishing or climate change that actually took place, and analyse any resolutions made.
Were specific resolutions taken? If not, why not? If so, what type of resolutions were they (see the slide on possible solutions)? Why do the measures seem promising (or why do they not)?

2.4 Learning by applying
To round off the module, the teacher can have the students take a short knowledge test. The test aims to secure a minimum knowledge of the topic and check how much the students retained.

In addition to the test, a more difficult question – the advanced question – is available.

An even more demanding question – the challenge question – is also available. Only students who have dealt with the topic in detail should tackle this question. By submitting their answers via the internet, individual students, student groups or entire classes can participate in the iconomix award.

Information on the iconomix award is available at: www.iconomix.ch/en/award.

3 Additional information

In this section, the German and French versions of the commentary for teachers provide references to textbooks used in Swiss upper secondary schools in the respective language regions and to other recommended resources from the same language regions. Please refer to the corresponding language versions.

4 Overview of module

	STEPS	DESCRIPTION	MEDIA/MATERIAL	TIME
PHASE 1 **Learning by doing** 20–45 minutes	Introduction	Introduction to strategy game, Fishpond.	Rules of game (slides) Check sheet for teachers (slide) Scoring system (slide) Score sheet for players Projector	5–10 minutes
	Fishpond game	Play game; possibly more than once.	Check sheet for teachers (slide) Score sheet for participants Masks Projector	10–30 minutes
	Evaluation of results	Record results. Award prizes.	Check sheet for teachers (slide) Scoring system (slide) Prizes Projector	5 minutes
PHASE 2 **Learning through dialogue** 45–120 minutes	Class discussion and review	Review game using questions provided. Teacher provides explanations and draws parallels to real life.	Commentary for teachers (incl. questions) Overfishing of cod (slide)	5–20 minutes
	Theory	Read knowledge sheet either in class or at home, or the teacher summarises the most important points.	Knowledge sheet	10–15 minutes
	Advanced task	Work through worksheet 1 and/ or worksheet 2, either in pairs or small groups. Discuss answers in class.	Worksheet 1 Worksheet 2 Sample answers	20–90 minutes
PHASE 3 **Learning by applying** 15+ minutes	Knowledge test	Work through knowledge test, either as an exercise or a test.	Knowledge test Sample answers	15–30 minutes
	Advanced question	Answer advanced question. Teacher provides solutions.	Advanced question Sample answers	Open-ended
	Challenge question	Answer challenge question. Participate in award.	Challenge question Information on iconomix award	Open-ended

COMMON POOL RESOURCES

Fishpond explained

1 Preparation and introduction

1.1 Get started

- Get everything together: check sheet for teachers, slides on rules of game, slide with scoring system, score sheet for players, projector, masks, prizes (optional).
- Seating may be arranged in a U-shape (optional).

COMMENTS

- If no masks or blindfolds are being used, players need to be seated in a U-shape (facing away from each other), so that they can take anonymous decisions.

1.2 Explain the game

- In this role-playing game, players are asked to fish in a pond.
- At the beginning of the game, the pond contains four fish per player (e.g. 20 players = 80 fish).
- The game is played in rounds. In each round, every player may catch between zero and three fish.
- The remaining fish multiply between rounds.
- The game lasts for a maximum of ten rounds.

- Explain the rules as clearly and precisely as possible. The slides provided can be used for this purpose.

1.3 Explain the aim and show prizes

- The aim of the game is to catch as many fish (points) as possible in ten rounds.

- Show the players the slide with the scoring system as well as any prizes for top scorers. Awarding prizes increases motivation.
- Option: A prize can be awarded to the whole class if the pond has not been depleted after ten rounds.

1.4 Describe stages of a round

- Each round consists of three 'casts' (opportunities to catch a fish). In the first cast, players raise their hands if they wish to catch a fish. To catch a second or third fish, players keep their hands raised in the second and third casts.
- After each round, players enter their new points and the total points on their score sheets.
- The number of fish remaining in the pond doubles between rounds. However, there is a capacity limit. The pond does not hold more than four fish per player.

- Players who choose not to catch a fish in a particular cast may not re-enter the round in a subsequent cast. This means that the second cast is only open to those who fished in the first cast, and the third cast is only open to those who fished in the second cast. Anyone wishing to catch just one fish, therefore, must do so in the first cast.
- Ensure at this stage that the players know how to complete the score sheet. Penalties can be introduced at a later stage (if the teacher wishes to include this option).

1.5 Additional remarks

- Hand out masks. As fishing is done anonymously, masks need to be worn during the rounds.
- Players should not talk to each other.

- Instead of masks, blindfolds may be used. Alternatively, players may be seated in a U-shape (facing away from each other).

2 The game

2.1 Play rounds without penalties

- The teacher enters the number of players and the number of fish in the pond at the beginning of the game on the check sheet.
- Players put on their masks.
- Players wishing to catch a fish raise their hands.
- The teacher enters the number of caught fish on the check sheet.
- The procedure is repeated for the second and third casts.
- Players take off their masks.
- The teacher enters the results (total number of fish caught, number of fish remaining) and the number of fish in the pond at the beginning of the next round.
- Players write down their points.

- A test round may be played (use first line to write down results).
- Go through the three casts of each round at a steady pace, so that the players cannot guess how many fish have been caught.

2.2 Introduce penalties

- After each round, players may anonymously give penalty points to punish those who caught three fish in that round (overuse).
- Players wishing to give penalty points raise their hands. Points cannot be given for free, however. Anyone wishing to award a penalty point has to give up one of their own points.
- The number of penalty points received by the players who caught three fish corresponds to the number of players giving penalty points minus one. However, no more than three penalty points may be given. These points are then deducted from the score.

- The penalty option may be introduced after two to three rounds or at the beginning of a new game. The slides explaining the rules may be used again at this point.
- The calculation of penalty points can be explained as follows: a certain effort is involved in punishing overuse; in order for the penalty to be effective, therefore, at least two players have to participate.
- In small groups (fewer than ten players), the penalty points may be calculated without the deduction of one point, and in big groups (more than twenty players), two points instead of one may be deducted.

2.3 Play rounds with penalties

- Players put on their masks.
- Play first three casts as before.
- Introduce penalties: players wishing to give penalty points raise their hands.
- The teacher enters the number of caught fish on the check sheet.
- Players take off their masks.
- The teacher enters the results (total number of fish caught, penalty points given/received) and the number of fish in the pond at the beginning of the next round.
- Players write down their points, deducting one point if they gave a penalty point or one to several penalty points if they themselves were penalised for having caught three fish.

- To increase the suspense when announcing the results to the class, keep the slide covered and reveal the results gradually, moving from left to right. (How many players gave penalty points? How many players received points? And so on.)

COMMON POOL RESOURCES

Fishpond explained

2.4 Call a conference

- A further option would be to call a class conference after a few rounds. Players get to discuss how they want to proceed. Any resolutions made may change the players' behaviour, but will not affect the laws of nature.
- Depending on the level of the class, the teacher could have the players themselves organise the conference, intervening only if inadmissible resolutions are made or if certain resolutions could disrupt the game.
- The teacher ends the conference after three minutes and starts the next round. The players receive no help in implementing the resolutions nor are they told if someone does not observe them. If necessary, the teacher can call another conference.

- Permissible resolutions include all those concerning the players' (non-binding) behaviour, such as agreeing that all players may take no more than two fish. Improvements to conditions (such as a recovery of the fish population or an adjustment to the cost of awarding penalty points) are not permissible. In case of doubt, the teacher decides whether or not a resolution is permissible.
- Decision-making is not easy and implementation can often raise tricky questions. This is also the case in reality at international conferences.

2.5 End of game

- The game ends after ten rounds or as soon as the pond is empty (depletion of resource).
- If the pond is depleted (which is normally the case), the fish remaining at the end of the previous round are divided among the players as follows: all players who caught a fish in the first cast are each given a fish. If there are fish left over, those who caught a fish in the second cast are given their second fish. This is continued until there are no fish left to allocate.
- Example: 15 fish were in the pond; 12 players caught a fish in the first cast, 5 caught a fish in the second cast, and 2 caught a fish in the third cast. First, the 12 players who caught a fish in the first cast are each given a fish. Subsequently, there are 3 fish left in the pond. All 5 players who caught a second fish are given a fish (the number of fish is rounded up to correspond to the number of players). After that, the pond is empty. Nobody receives a third fish.

- As an exception, the game may be ended before the ten rounds have been completed, even if the pond has not been depleted (e.g. if a learning effect is visible at an earlier stage).

2.6 Record individual results and marks

- Place slide with the scoring system on projector.
- Players make a note of their marks.
- Prizes may be awarded to top scorers (optional).

- If possible, maintain anonymity also at this stage. Do not ask the players to call out their results.

2.7 Record performance of class as a whole

- The teacher calculates the total number of fish caught and the averages (per player, per player and round) and enters them on the check sheet.
- The average calculated per player and round is compared with the most sustainable solution, in which all players could have caught two fish per round, i.e. twenty fish.
- To calculate the average per player and round, the points are divided by ten, even if the pond was empty before the ten rounds had been completed. (It is possible to play ten rounds if players do not catch more than two fish per round.)

- A collective result does not take the penalties (penalty points given and received) into account and cannot be compared directly with individual results.

COMMON POOL RESOURCES

Knowledge sheet

Common pool resources

What does the economic term 'common pool resource' really mean? What exactly is a 'common pool'? The following example should help shed some light on the origins of the term.

Imagine a small, rural community. The community owns a large expanse of common land (also referred to as commonage or commons), which all the local farmers are entitled to use as pasture land for their cattle. Having the cows graze on common pasture offers a number of advantages over doing so on a private piece of land. For one thing, fewer herdsmen are needed to watch the livestock.

This free access becomes problematic if the farmers start putting more and more cows onto the pasture land. Each additional cow takes its toll on the pasture's resources. After all, a pasture can only produce so much grass. Overuse will eventually lead to overgrazing and the degradation of the pasture. For the moment, however, it is in each farmer's best interest to put as many cows as possible onto the common pasture land. The farmer receives all of the benefits (in the form of meat and milk), while the damage to the commonage is shared by the entire group of farmers (overgrazed and damaged pasture land).[1]

The fact that commonage is at risk of being irreparably damaged was recognised very early on. As a result, many communities came up with elaborate systems of rules which restricted access to the common land and penalised any violation with a hefty fine. Thus, the presence of common land did not necessarily lead to its overexploitation. Other communities decided to parcel out the land and sell it among the farming community, thereby transferring the responsibility for the sustainable management of land to the individual farmers.

The economic term 'common pool resource' represents a commodity which has the two characteristics typical of common land. First, access to the resource is open to everyone, or rather, no one can be excluded from using it. Second, there is rivalry in consumption between the different users of the resource. All this means is that the resource's availability is not unlimited. The result is what is known as the tragedy of the commons: given the scarcity of the resource, it would be in everyone's best interest to exercise some restraint when using the common pool resource. On an individual level, however, there is a tendency to try and use as much of the resource as possible. Because for every additional unit consumed, the personal benefits increase. However, the costs incurred are not borne completely by the initiator, but are instead shared among all users. In economics, this is referred to as a negative externality. If nothing is undertaken to stop this behaviour, chances are the result will be overexploitation and, in severe cases, complete depletion of the resource. Typical examples of common pool resources include fishing grounds, drinking water, forests, public traffic routes, shared laundries in apartment blocks and even common rooms in youth clubs.

Common pool resources should not be confused with public goods. Although public goods are also accessible to everyone, they can be used simultaneously by any number of people (non-rivalry). Thus, in the case of public goods, there is no danger of overuse, but rather an undersupply. The reason for this being that as long as everyone else makes a contribution to the provision of the public good, it makes little sense – from a selfish perspective – to make a personal contribution. This socially unacceptable behaviour is referred to as free riding. A classic example of a public good is national defence. Every citizen benefits from their country's national defence, regardless of how many other citizens also benefit. Consequently, only very few are prepared to voluntarily pay for this protection or do military service. Solutions to this problem include making military service obligatory and imposing taxes so as to help finance the country's system of national defence.
Most goods, however, are neither common pool resources nor public goods, but rather private goods. These are characterised by the fact that other consumers can be excluded from using them. In addition – as is also the case with common pool resources – rivalry exists in their consumption. Because private goods generally cost something, however, the problem of overuse is systematically avoided.

Three ways to combat overuse:

- **Privatise:** The common pool resource is turned into a private good. The property rights are redefined, which in turn makes them easier to enforce. This allows private owners to exclude everyone else from using the good or to request appropriate remuneration.
- **Restrict access:** One way to do this is for the government to introduce rules or bans governing access to the common

COMMON POOL RESOURCES

Knowledge sheet

pool resource. While the good essentially remains a common pool resource, access is no longer free. Examples of this include fishing quotas and bans on hunting wild animals.

- **Increase the price:** The cost of using the common pool resource is raised to such a point that each consumer bears the costs they themselves incur. The state could, for instance, introduce incentive taxes on CO_2 emissions in an effort to slow global warming. In economics, this approach is referred to as the internalisation of negative externalities.

Which of these solutions to the tragedy of the commons is most appropriate depends on the individual situation. It is worth noting, however, that all three of them incur costs which should not be underestimated. Take rainforests for instance – access can only be prevented by investing in expensive surveillance systems. In addition, specific proposals have to be formulated and political majorities drummed up. This is no small feat, particularly on an international level. Binding agreements in climate policy, for example, are very difficult to attain. This is because of the vast number of people affected and the fact that interests are so diverse. If negotiation costs are low, however, then private solutions could also be considered. In small groups in particular, certain types of expected behaviour (social norms) can be enforced through the use of sanctions. For instance, a flatmate in shared accommodation who never helps with the cleaning can be put under pressure by the other flatmates to contribute.

[1] Because the overuse of the commonage seems virtually unavoidable, this phenomenon also gets referred to as the tragedy of the commons. The term first appeared in an influential article by Garrett Hardin, in which the example of common pasture land is used to describe the aforementioned mechanisms and incentives. The article – entitled 'The tragedy of the commons' – was first published in 1968.

SUMMARY

A common pool resource, in the economic sense, has two main characteristics:

- Nobody can be excluded from consuming the good (non-exclusion).
- Those who use or consume the good reduce the benefit for other users (rivalry).

Generally, we distinguish between the following economic types of goods:

	Rivalrous	Non-rivalrous
Excludable	Private goods	Club goods
Non-excludable	Common pool resources	Public goods

If the costs incurred by an action are not borne completely by the initiator, the result is referred to as a negative externality.

The incentives that exist in connection with all common pool resources (and with all activities that generate negative externalities) often lead to an overuse of a good from the vantage point of the community. This phenomenon is referred to as the tragedy of the commons and is an example of market failure.

Ways of solving this include the introduction of private ownership rights (privatisation), government intervention by means of bans, rules, incentive taxes or fees, as well as privately negotiated solutions and (in small groups) effective social norms.

COMMON POOL RESOURCES

Worksheet 2

1. Two neighbouring cities, A and B, are connected by just one public road. The road is toll free and no restrictions govern its use. Owing to the ever-growing volume of traffic, the road is frequently congested and delays can be lengthy. Most of the people using the road are from the two cities.

a. What makes this road a common pool resource?

b. One possible solution would be to expand the road from two lanes to four (two lanes in each direction). Would this solve the problem permanently?

c. Another solution would be to restrict the number of times a vehicle can use the road each week to a maximum of four trips in each direction, with the police ensuring that this is observed. Does this solution make economic sense?

2. Working in pairs or small groups, come up with possible solutions for a specific example of a tragedy of the commons. (Examples: overfishing in public waters, excessive emissions of CO_2 where atmospheric absorption is limited, dirty rehearsal room owing to constant use by several bands, pilferage of food from fridge by several family members.)

Summarise and explain your preferred solution.

COMMON POOL RESOURCES

Advanced question

Why are some wild animals such as whales and tigers endangered, but domestic animals such as chickens, sheep and cows are not? Explain your answer using economic argumentation.

Answer this question in a few sentences.

COMMON POOL RESOURCES

Worksheet 2

1. Two neighbouring cities, A and B, are connected by just one public road. The road is toll free and no restrictions govern its use. Owing to the ever-growing volume of traffic, the road is frequently congested and delays can be lengthy. Most of the people using the road are from the two cities.

a. What makes this road a common pool resource?

No one is excluded from using the road (although this would be technically possible in this particular case) and, owing to the high volume of traffic, a certain rivalry exists among users.

b. One possible solution would be to expand the road from two lanes to four (two lanes in each direction). Would this solve the problem permanently?

This would relieve the traffic congestion problem in the short term. However, despite the increased capacity, rivalry in the use of the road may return. This is likely to be the case if the number of road users grows owing to the increased capacity.

c. Another solution would be to restrict the number of times a vehicle can use the road each week to a maximum of four trips in each direction, with the police ensuring that this is observed. Does this solution make economic sense?

No. Not all road users are equally dependent on the road. Some motorists may have to use the road daily, while others may not have to use it at all. This factor needs to be taken into consideration in order for the solution to make economic sense. For instance, those who appreciate the service (and are willing to pay for it), should be able to use the road more often than others, and also pay more to do so.

2. Working in pairs or small groups, come up with possible solutions for a specific example of a tragedy of the commons. (Examples: overfishing in public waters, excessive emissions of CO_2 where atmospheric absorption is limited, dirty rehearsal room owing to constant use by several bands, pilferage of food from fridge by several family members.)

Summarise and explain your preferred solution.

Individual answers. For suggestions, see the slide on possible solutions.

COMMON POOL RESOURCES

Advanced question

Why are some wild animals such as whales and tigers endangered, but domestic animals such as chickens, sheep and cows are not? Explain your answer using economic argumentation.

Answer this question in a few sentences.

0 point: No answer or incorrect answer.

1 point: Answer that touches on the tragedy of the commons phenomenon (some wild animals are overhunted or their habitat is destroyed).

2 points: Answer that addresses the heart of the issue, using property rights as an argument. Unlike farm animals, wild animals are not subject to private property rights, with the result that certain animals are overhunted and the people responsible for this have no incentive to preserve the species. If property rights were defined for wild animals and if they were enforceable, there would be an incentive for the owners to prevent their animals from dying out (as is the case for farm animals, such as chickens).

Fishpond in brief

- You go fishing in a pond.
- You fish alone and anonymously (wearing a mask) over several rounds.
- The game ends either when all the fish are caught or at the end of the tenth round.
- Number of fish at the beginning of the game: number of players x 4.
- The number of fish that can be caught in any one round ranges from zero to three per person.
- Your aim is to catch as many fish as possible (see scoring system).
- Please note: Although the fish population recovers between rounds, it does so only to a limited extent.

Fishpond by round

- Players put on their masks before a round begins. Talking is not allowed.
- Players wishing to catch a FIRST fish should raise their hand when prompted.
- Players wishing to catch a SECOND fish should raise their hand when the second cast is called.
- Players wishing to catch a THIRD fish should raise their hand when the third cast is called.
- Please note: The second cast is only open to those who fished in the first cast, and the third cast is only open to those who fished in the first and second casts. Players who choose not to catch a fish in the first cast can thus not fish in the second or third cast.
- Players take off their masks and note down how many fish they caught on their score sheets.
- The number of fish remaining in the pond doubles between rounds. The fish population will never exceed what it was at the beginning of the game, however (four fish per player).

Fishpond with penalties

- A penalty system can be introduced.
- After each round, the players are asked to raise their hand if they wish to penalise overuse.
- Penalty points cannot be given for free, however. Anyone wishing to award one has to give up one of their own points.
- This means that anyone who caught three fish in that round will be penalised. The number of penalty points they receive corresponds to the number of players giving penalty points minus one.
- No more than three penalty points can be given, however. Two examples: 3 players giving penalty points = 2 penalty points; 7 players giving penalty points = 3 penalty points.
- Penalty points are awarded anonymously and before the result of the round is announced (masks should therefore only be taken off afterwards).

Check sheet

Number of players (pl.): _____ Mark: _____

	NUMBER OF FISH AT BEGINNING OF ROUND	FIRST FISH	SECOND FISH	THIRD FISH	TOTAL NUMBER OF FISH CAUGHT	NUMBER OF FISH REMAIN-ING AT END OF ROUND	PENALTY POINTS: NUMBER OF PL. GIVING PENALTY POINTS	PENALTY POINTS: NUMBER OF PENALTY POINTS RECEIVED PER PL.
TEST								–
1	*							–
2								–
3								–
4								–
5								–
6								–
7								–
8								–
9								–
10								–
				Total				
				Average per player				
				Average per player and round**				

* Four fish per player, i.e. the maximum capacity of the pond.
** Divided by 10 (rounds), even if the pond is depleted earlier.

Scoring system

Points and marks

0–2	3–4	5–6	7–9	10–11	12–14	15–16	17–19	20–21	22–24	25–30
1	1½	2	2½	3	3½	4	4½	5	5½	6

Note for teacher:
This table can also be used if the game ends early as a result of the depletion of the resource (if no fish are left before the ten rounds have been played). If the game is cut short due to lack of time and the resource has not yet been depleted, add half a mark for each round not played (a normal game lasts ten rounds). Example: A student with 15 points receives a mark of 4½ after 9 rounds or a 5 after 8 rounds.

Solving the tragedy of the commons*

Privatisation
- Define and guarantee private property rights. This addresses the heart of the issue (no common pool resource and no negative externalities).
- However, this approach can be problematic as it is generally almost impossible or too expensive to put into effect, particularly with regard to the enforcement.

Avoid overuse
- Commonage should remain commonage. Private or government solutions should aim to restrict overuse and negative externalities, however.

Government measures**
- Introduce prohibitions and restrictions, and enforce them through supervision and the use of sanctions.
- Restrict the incentive to overuse a resource by introducing fees and incentive taxes.

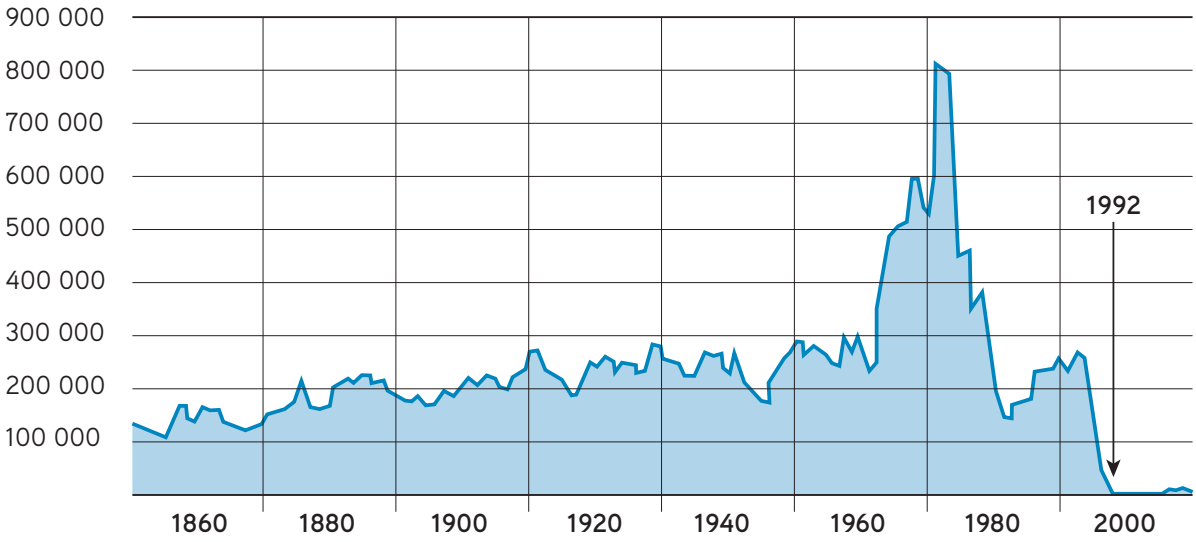
Private measures
- Effect of social norms (expected behaviour in a group, which may be enforced with the help of sanctions).
- Negotiate and monitor voluntary agreements (rules, bans, compensation), and possibly enforce them through the use of sanctions.

* Universally valid in the case of negative externalities.
** To expand on this topic, a look at the following solution might be interesting: the creation of markets on which certificates for the use of a particular resource are negotiated (e.g. rights for CO_2 emissions).

Collapse of Atlantic cod stocks

off the east coast of Newfoundland (Canada)

Fish landings in tonnes



Source: World Resources Institute (2005), Millennium Ecosystem Assessment, Washington, DC, www.maweb.org.