Research on online experimental teaching platform of economics

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Abstract: Economics is a practical course. By introducing experimental teaching methods into economics classroom, students' participation in the classroom can be improved and the teaching effect can be improved. At present, the experimental teaching of economics mainly includes two methods: role playing and computer assistance, which respectively have the problems of high cost and high requirements for software and hardware environment, which limits the degree of integration of experimental teaching into economics classroom. In order to achieve a better integration of economics classroom, this paper designs a set of economics experiment teaching tools with low cost and high flexibility, which has the characteristics of strong interactivity and multi-end access. Through this set of tools, economics teachers can carry out experimental teaching by means of parameter adjustment, evolution and parameter labeling, which has positive significance for fully integrating experimental teaching in economics classroom and improving teaching effect.

Key words: Economics; Experimental teaching; Interactive; Unity of theory and realit

1. Introduction

Economics is a highly practical course, which mainly involves the law of market entities' engaging in production, consumption and other market activities under the premise of rational economic man. Most of its theories are derived from specific market activities. The current teaching of economics focuses on the indoctrination of models and theories, resulting in students' difficulty in understanding and lack of initiative. The use of various teaching methods, including experiment teaching, in economics courses is conducive to improving the traditional "Talk and Chalk" teaching and enhancing the teaching effect.

By introducing experiment teaching into economics class, an exploratory and interactive learning environment can be created for students, which can help students summarize rules and discover knowledge by themselves, and then achieve the goal of independent learning. In 1948, Professor Chamberlain of Harvard University introduced the demand and supply experiment into the economics class for the first time, which was recognized by later generations as the beginning of economics becoming an experimental science. With the progress of computer-aided experiment technology, economic experiments are becoming more and more common.

Experimental teaching helps to improve the level of economics teaching, and how to integrate experimental teaching into economics teaching is the focus of current scholars. Wen Xiaohui, a domestic scholar, emphasizes three issues that should be paid attention to in economics experiment teaching: scientific design of experiment scheme, close integration with theoretical teaching and optimization of software and hardware environment. Yan Ran believes that in economics teaching, reasonable experimental methods should be selected according to teaching tasks and mobile phones should be fully utilized to flexibly set up experimental links. Zhang Zhinan et al. Believe that the application of experimental teaching should also take into account the teaching cost and teaching platform of the school, and should serve the teaching goal rather than experiment for the sake of experiment. Cao Huimin summarized several problems faced by the experimental teaching of economics in local colleges and universities, including fragmentation of experimental content, low level of experimental teaching and high cost of experimental input.

To sum up, economics experiment teaching should focus on teaching objectives and be fully integrated with theoretical teaching, which requires high flexibility in experimental methods. Scholars have made numerous explorations into the forms of economic experiments, and there are two main methods of economic experiment at present:

●Role-playing methods: for example, foreign scholars such as MnaB teach the core ideas of economics through classroom games; In the economics class, Yang Juan et al. let students participate in "market decision-making" to understand the principles of economics, and students changed from passive acceptance to active exploration, which improved their independent thinking and innovation ability.

●Computer-assisted methods: For example, Innocenti A sorted out the experimental methods of economics in virtual simulation and advocated classifying virtual simulation experiments according to the degree of immersion. Shi Yuren et al. proposed an economic experimental model based on cloud model; Zhang Liang et al. developed experiments through Netlogo and applied them to the experimental teaching of economics and management major; Qiao Daifu analyzed the economics experiment teaching strategy supported by virtual simulation technology.

The above research plays an important role in expanding the experimental means of economics, but there are still some problems. The organization cost of role-playing experiments is high, and the computer-aided experiments require certain software and hardware environment support, which limits the integration of economics experiments and economics classrooms. In view of the above problems, this question intends to use a new generation of information technology and develop an economics experiment teaching platform according to the knowledge context and characteristics of economics. The platform has the characteristics of strong interaction, high flexibility and low cost, so as to realize the full integration of experimental teaching and theoretical teaching in economics classroom.

2. Design ideas

2.1 Design goals

In order to better achieve the integration of experiment and classroom, and solve the problems of high cost, poor flexibility and weak

interaction of economics experiment, the developed economics experiment teaching platform should achieve the following goals.

(1) As a whole, the experimental teaching platform starts from the real economic scene, through simulation, dynamic curve and other ways, leads to the economic theory, and builds the bridge between the real economic problems and the abstract economic theory.

(2) Dynamic interaction, students adjust parameters on the platform and other interactive adjustment of economic parameters, the platform according to the adjustment of parameters, and the calculation results through simulation graphics, function curves and table text and other ways to feedback to students, to achieve interactive economic experiments.

(3) Multi-terminal access, the platform can be multi-terminal access, that is, it can be accessed in the PC segment and the mobile phone, it can be embedded in the main online teaching platform, and it can be fully integrated with the economics classroom.

(4) Flexible application, the experimental teaching platform is easy to deploy, the dependence on software and hardware environment is as low as possible, the use and maintenance cost is as low as possible, and the cost of carrying out economic experiments is reduced.

2.2 Technical scheme

In order to achieve the design goal, the overall design of the system includes four modules, which are model layer module, view layer module, marker pen module and controller module.

The model layer module encapsulates the economic model, realizes the model function of the economics course, or encapsulates the individual and its decision function in the economic market in an object-oriented way. The model layer module is a calculation module, which can accept experimental parameters and adjustment of experimental parameters from the view layer, update the economic variables in the model through the simulation decision of the economic model function or the decision function of the economic individual, and then display the results by the view layer.

The view layer provides the user interface, which can be used to generate the input area, simulation area, chart area and data area, in which the user can adjust the experimental parameters in a dynamic interactive way, control the experiment process, and observe the experimental results in a variety of ways including data, function curve and simulation curve. The functions of each view area are as follows:

●input area: Used to adjust experimental model parameters, using html5 input (type=range) component to adjust experimental parameters (i.e. model layer parameters).

●Simulation area: The experimental phenomenon is displayed in the way of simulation graphics (using graphic elements in rapheal.js). In addition, the simulation area can also accept the adjustment of experimental parameters, so as to control the experiment.

●Chart area: the use of echart, in the form of a function curve to show the experimental results of the data, in addition, the icon area can also be marked operation, that is, click a point in the chart, so as to obtain the experimental data corresponding to the mark point and display in the data area.

●Data area: to show the experimental results in the form of a data table.

Marker pen module is used to provide more flexible interaction in the chart area, so that the experimenter can better understand the economic phenomenon contained in the function curve and the mathematical principle behind it. The module captures click events in the icon area, and generates marker points at the click position, and converts the page coordinates of the marker points into parameters of the economic model. The marking points have numbering properties. By displaying the marking points in the chart area and the corresponding parameters of the economic model in the data area at the same time, a flexible interactive experiment method is realized.

Control layer module, mostly used in evolutionary experiments, this module provides the next step, pause and other control buttons to control the process of evolutionary experiments.

2.3 Type of experiment

According to the main experimental needs in economics, the platform can support three types of experiments, namely parameter tuning experiments, evolution experiments and labeling experiments.

(1) Parameter tuning experiment, this type of experiment is suitable for the scene that requires the experimenter to adjust the parameters and then dynamically observe the experimental results. In this type of experiment, the user adjusts the experimental parameters through the scroll bar in the input area, and performs the experiment by observing and recording the function curve in the chart area, the simulation image changes in the simulation area, and the real-time dynamic changes of the experimental data in the data area. In this type of experiment, after the user adjusts the parameters in the input area, the parameters are passed into the model layer, and after calculation, the model operation results are displayed through the simulation graph, function graph and chart data. Its flow chart is shown in Figure 1.

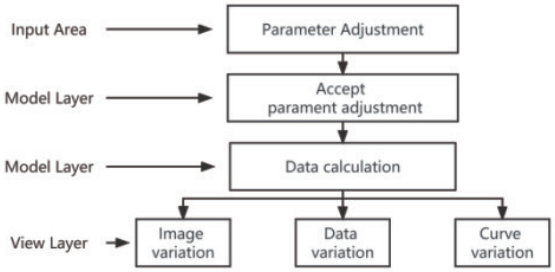


Figure 1. Process flow of parameter tuning experiment

(2) Evolutionary experiments, some economic phenomena in economics are the result of group evolution, and this type of experiments mainly correspond to the simulation experiments of this part of knowledge points. The experimenter clicked the button of the control layer module, which triggered the individuals in the model layer to make decisions continuously. The experiment was carried out by observing the simulation graph in the simulation area, the function curve in the chart area and the data in the data area. In this kind of experiment, after the experimenter clicked the button in the input area, the economic entities encapsulated in the model layer were triggered to make decisions according to the decision function, and the economic variables affected by the decision were further displayed through curves, graphs and data. The processing flow is shown in Figure 2.

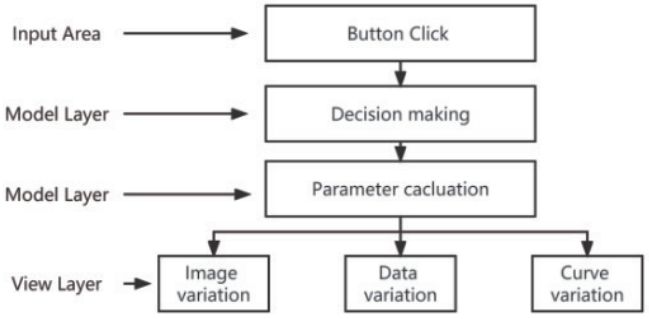


Figure 2. Process flow of evolutionary experiment

Labeled experiments, which provide experimenters with point-labeled interactive experiments based on function curves. This type of experiment is combined with the parameter adjustment experiment to achieve the experimental purpose. The parameter adjustment of the experimenter in the input area triggers the dynamic change of the function curve in the chart area, and the click operation in the chart area triggers the generation of marked points and marked data. By observing the position relationship between the marks and the function curve, the experimenters can conduct experiments on the economic phenomena and the mathematical principles behind them. In this type of experiment, the user clicks on the chart area to form the marked points, and the marker pen module converts the marked coordinates into economic model parameters, generates data through the calculation of the model layer, and then displays the marked data corresponding to the marked points in the chart area. The main processing flow is shown in Figure 3.

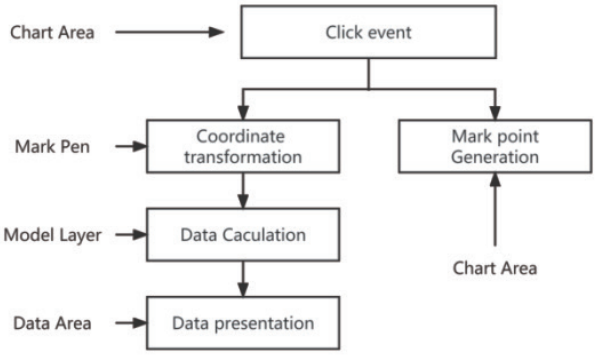


FIG. 3 Process flow of labeled experiments

3. Application Case

A total of 14 experimental economics teaching platforms are designed in this paper. Including supply and demand and market balance, consumer choice, consumer equilibrium, production and cost of firm, long-term production function of firm, market strategy of perfect competition firm, market evolution of perfect competition market, market strategy of imperfect competition firm, market strategy of oligopoly firm, labor supply equilibrium of laborers, labor strategy, general equilibrium of exchange, and macroeconomic income - The expenditure model and the IS-LM model of macroeconomics basically cover all knowledge points of microeconomics and some knowledge points of macroeconomics. In this chapter, representative tools of three types of experiments are selected for introduction.

3.1 Perfectly competitive market

The perfect competition market is designed as an evolutionary experiment, and the experiment simulates the evolution law of the perfect competition market. The experiment interface includes four parts: input area, control area, simulation area and chart area. The experiment simulates the decision-making of high-tech enterprises and high-tech enterprises in the market. The cost of high-tech enterprises is lower and the cost of low-tech enterprises is higher. The two color parks in the simulation area represent low-tech enterprises and high-tech enterprises respectively. The experimenter can set the initial product price and labor price in the input area, and trigger the decision

of the enterprise by clicking the STEP button in the control area, so that the enterprise can make decisions in the establishment, continued operation or closure. When the market price is higher than the lowest average cost of the manufacturer, the manufacturer can make profits and will choose to continue to operate, and at the same time, new manufacturers may be established; When the market price is lower than the lowest average cost of the manufacturer, the manufacturer can not make a profit, and there is a certain probability of bankruptcy. No matter what the initial price and the initial price setting of the experiment are, the final market price will converge to the lowest average cost of high-tech enterprises. By observing the phenomena in the evolutionary iteration, the experimenter can fully understand the principle of perfectly competitive market based on the graph simulation of the simulation area and the curve change of the chart area. The solution surface of this experiment is shown in Figure 4.

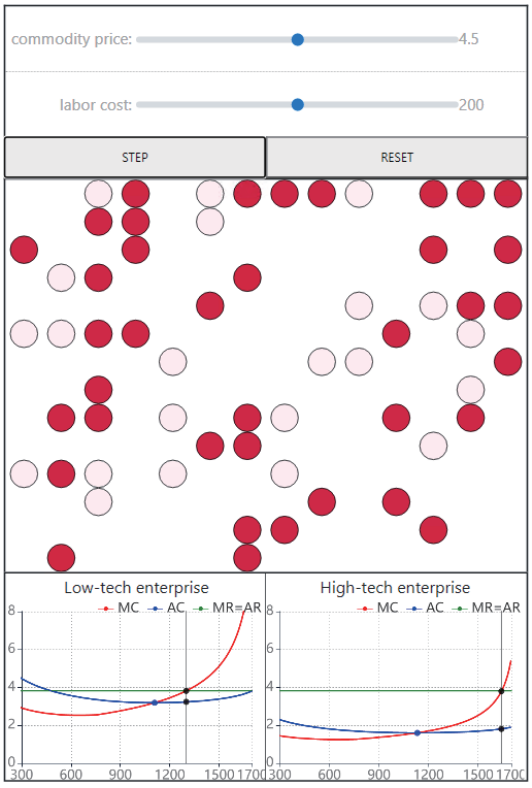


Figure 4. Solution surface of perfect competition market experiment

3.2 Duopoly competition

The duopoly competition experiment is designed as a tuning experiment, including input area, simulation area and chart area, and the experiment simulates the evolution of duopoly market. The experimenter can adjust the output of the two enterprises in the input area. The red and blue circles in the simulation area represent the income of enterprises 1 and 2 respectively. The upper part of the chart area shows the income curve of the two enterprises, and the lower part shows the income curve of the market formed by the two oligopoly enterprises. The experimenter can adjust the output of firms 1 and 2 according to the principle of maximization of revenue (that is, the output is adjusted to the highest point of the revenue curve). In the collude state, both firms can adjust their output to maximize their own returns, and the experimenter can adjust the output of the two firms alternately to reach the highest return. In the adjustment process, the return curves of the two firms influence each other, and finally benefit from the point where both firms reach the highest return, but the overall return of the market is not the largest. In the collusive state, when the two companies reach the same price, they can eventually reach the maximum market return, but the two companies do not reach the maximum return in the current state, which will cause the enterprises to violate the price agreement. Through this experiment, students can understand the mutual influence and game principle of duopoly market in a more visual and intuitive way.

3.3 Consumer Equilibrium

The consumer equilibrium experiment is designed as a marker-type experiment, which simulates the background and consumer choice under different parameters. In the input area, the user can input the income of the two alternative prices and the disposable income of the consumer, and can also adjust the utility value corresponding to the indifference curve in the chart area by adjusting the auxiliary line utility slide box. The budget constraint line and indifference curve are displayed in the chart area. By adjusting the position of indifference curve, the two are adjusted to the tangent position, and the tangent point corresponds to the optimal choice of consumers. The experimenter can click the tangent point to generate a mark, and the corresponding experimental parameters will be recorded in the number zone. By adjusting the parameters and marking the tangent points, consumers can explore the final decision of consumers under different prices or different incomes. Students can better understand the corresponding knowledge points through interactive parameter adjustment and marking.

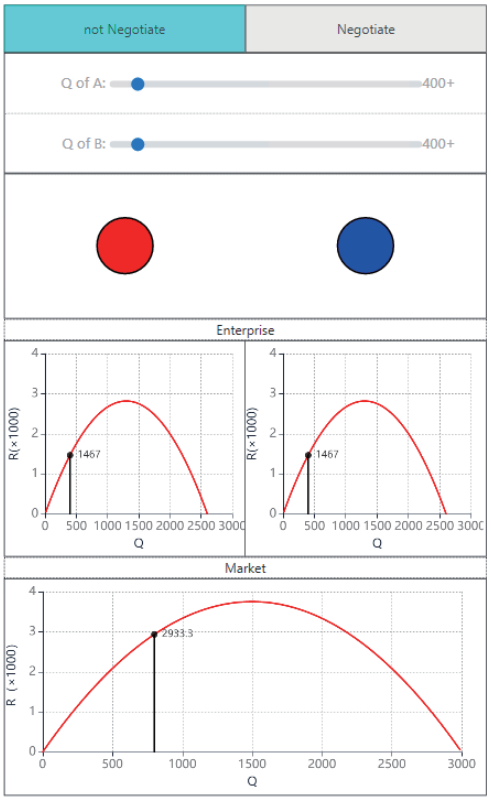
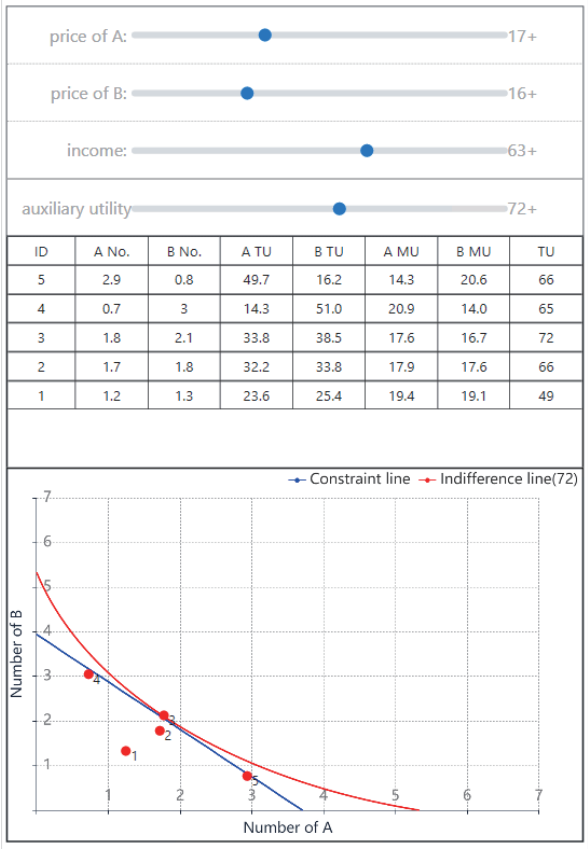


FIG. 5 Duopoly market experiment interface



ID	A No.	B No.	A TU	B TU	A MU	B MU	TU
5	2.9	0.8	49.7	16.2	14.3	20.6	66
4	0.7	3	14.3	51.0	20.9	14.0	65
3	1.8	2.1	33.8	38.5	17.6	16.7	72
2	1.7	1.8	32.2	33.8	17.9	17.6	66
1	1.2	1.3	23.6	25.4	19.4	19.1	49

Figure 6. Consumer balance experiment interface

4. Epilogue

This paper develops a set of economics experiment teaching tools with low implementation cost, strong interaction and high flexibility, which is helpful to better use of experiment teaching methods in economics classroom, and has positive significance for popularizing economics experiment teaching and improving economics effect. Under the background of the rapid development of information technology, the effective integration of the strong interactive characteristics of information technology and economics classroom is helpful to stimulate and enhance students' subjectivity and achieve ideal classroom teaching results.

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