

The effectiveness of computer-based simulation games for educational purposes: the Review of MPA students' experience

Anna G. Sanina, Evgeniia A. Kutergina

National Research University "Higher School of Economics," Saint Petersburg, Russia

anna.g.sanina@gmail.com

evg-kutergina@yandex.ru

Abstract: Computer simulation, an active learning technique, is now one of the advanced pedagogical technologies. The use of simulation games in the educational process allows students to gain a firsthand understanding of the processes of real life. Public administration, public policy, and political science courses increasingly adopt simulation games in universities worldwide. Besides person-to-person simulation games, there are computer-based simulations in public administration education. Currently in Russia the use of computer-based simulation games in Master of Public Administration (MPA) curricula is quite limited. This paper focuses on computer-based simulation games for students of MPA programs. Our aim was to analyze outcomes of implementing such games in MPA curricula. We have done so by (1) developing three computer-based simulation games about allocating public finances, (2) testing the games in the learning process, and (3) conducting a posttest examination to evaluate the effect of simulation games on students' knowledge of municipal finances. This study was conducted in the National Research University Higher School of Economics (HSE) and in the Russian Presidential Academy of National Economy and Public Administration (RANEPA) during the period September to December 2015, in Saint Petersburg, Russia. Two groups of students were randomly selected in each university and then randomly allocated either to the experimental or the control group. In control groups (n=12 in HSE, n=13 in RANEPA) students had traditional lectures. In experimental groups (n=12 in HSE, n=13 in RANEPA) students played three simulation games apart from traditional lectures. This exploratory research shows that the use of computer-based simulation games in MPA curricula can improve students' outcomes by 38%. In general, the experimental groups had better performance on the posttest examination (figure 2). Students in the HSE experimental group had 27.5% better scores than students in the HSE control group. Students of the RANEPA experimental group had 38.0% better scores than students in the RANEPA control group. Research indicates that lecture-based courses are less effective than courses with more interactive approaches. Therefore, our study highlights the need to implement computer-based simulation games in MPA programs in Russian universities. Computer-based simulation games provide students with practical skills for their future careers.

Keywords: active learning, simulation, computer-based simulation games, students of MPA programs, public administration, municipal finance

Introduction and problem statement

Active learning in the educational process is a widespread topic for discussion. Chris (2012) states that active learning means the engagement of students in the learning process. Students think about what they are doing. There are such active learning techniques as “problem-solving exercises, informal small groups, simulations, case studies, role-playing” (Meyers & Jones, 1993). Active learning techniques contribute to “both a comprehensive understanding of course material and the skills they need to excel” (Auster & Wylie, 2006).

Chris (2012) has noticed that public administration, public policy, and political science courses increasingly adopt different types of active learning, but the major type they turn to is simulation. In this study attention is paid to the simulation games. After reviewing the experience of implementing simulation games and exercises in curricula, we concluded that all simulation games could be divided into several groups, depending on the type of subject that is simulated. One group of simulations could be called *person-to-person simulation games*; in these only people take part. Another type of simulation games is computer-based simulations. In such games, the interaction is between the computer and a person. They are *person-to-computer simulation games*. Computer-based simulations frequently exist in a computer game format.

Computer-based simulations in public administration education is a popular active learning technique in European and USA universities. Among recent studies, we could refer to Lengwiler (2004) (monetary policy simulation game), Hsieh et al. (2006) (health policies computation simulation model), Weir and Baranowski (2011) (game *Civilization*), Harding, Garrett & Wang (2015) (computer-simulation game about decision-making within legal frameworks).

While the literature offers broad insight into the impact of simulation games on MPA students in Europe and the USA, the experience of Russian universities is not represented. Currently, the teaching of public and municipal administration disciplines in Russia involves simulation games to a very limited extent. The main reason is the "theoretical overload" of curricula, which are focused primarily on knowledge and memorization and only secondarily on skills and competencies. To make effective decisions, however, state and municipal officials must not only have a thorough knowledge of the legal framework and of economic governance instruments; they must also be able to navigate in a complex socioeconomic and political reality.

We propose changing the approach to MPA program education in Russia through introduction of simulation games so that students could gain practical skills within the

classroom. Our focus in this paper is on the use of computer-based simulation games for MPA students, and our aim was to analyze the outcomes of implementing games in an MPA curriculum. For this research, we have carried out our analysis by (1) developing three computer-based simulation games about allocating public finances, (2) testing games in the learning process, and (3) conducting a questionnaire survey of MPA students who studied the same course with and without the computer-based simulation games. This exploratory research shows that the use of computer-based simulation games in MPA curricula improves students' outcomes. Therefore, our study highlights the need to implement simulation games in MPA programs. In the rest of the paper, we first describe our games and then present results of their implementation.

Description of computer-based simulation games

The financial sector in public administration is one of the most important for understanding and successful professional performance. In the framework of a master's degree program, it is necessary to develop practical skills both in the analysis of socioeconomic situations in the region and in budget adoption and implementation. We believe it is important to introduce computer-based simulation games dealing with municipal finances into the educational process in the field of public administration.

The content and structure of games

Under the preliminary agreement, MG System company has provided a computer-based simulation game template. The template is a table with data that are reflected in the game. We filled templates with content necessary for allocation-of-municipal-finances games, and the company uploaded them on its platform.

To enhance learning outcomes we developed together with students three games on the subject of municipal budgets. Bovill, Cook-Sather and Felten (2011) state that co-creation develops a student's meta-cognitive awareness about what is being done. Three gaming scenarios give students the opportunity to practice the allocation of budgets in various types of municipal structures. The three different simulators provide the opportunity to understand, feel, and remember the difference.

The first gaming scenario was developed for rural-settlement budget management. Rural settlement is one or several rural-type settlements that are united by common territory (townships, villages, stanitsas, hamlets, farm yards, kishlaks, auls). The second gaming scenario is related to an urban settlement, a town or other urban-type settlement. The third scenario

reflects budget management for an intracity area of a city of federal importance, which is part of the territory of a city of federal importance.

During the process of playing, the students will "put themselves in the shoes" of a mayor. The game can be played either by an individual student (one participant = one mayor = one computer) or by a group of students. In the latter case, it becomes a team game, a multiplayer game (a group of participants = one mayor). The participants make decisions as a group on budget distribution. The choice of individual or multiplayer mode depends on the preferences of instructor and on the number of students in the group. All the students play simultaneously. The students govern one and the same city (depending on the playscript), but with the use of different strategies. All the actions are performed in real-time mode.

Each game comprises 12 periods, and each period imitates one year's duration. A period is a case situation that has to be solved. The time for decision making for each period is strictly limited by the teacher in the game settings. This means that the players are not able to turn the game back by one period and then continue entering the solution. The periods start and end at the same time for all the students.

We specified various government regulations in the contents of the periods and included experts' assessment of the significance of the municipal economy areas, and other input data. The participants need this information to make decisions on budget distribution. Just as in real life, a player has deputies who bring in new information about what is going on in the city after every period. In addition, during every period the player studies the results of polling among the citizens. All of this information has been compiled by us in advance for each period and for each playscript. In the process of playing, the master's degree students learn to use and apply the form of road map, variants of the city executive board's report on implementing the road map of the social and economic development of the city, the form of PEST analysis, the form of SWOT analysis, and the task recording sheet.

The participants distribute the city's budget in each period to five key sectors: (1) utilities sector and land improvements; (2) road facilities and urban transport; (3) health care and social security; (4) education and culture; and (5) development of the economy. All the periods are interconnected in a mathematical model. If the participants overlook information containing prompts on budget distribution, their city's budget revenue for the next "year" becomes lower than in the previous period. The city's rating is changed subsequently. After each period the participants can learn which city is the best one and receive an award for the most efficient distribution of the city's budget revenue. Participants can also analyze where an error was committed (on their own or with the teacher's help).

The game process

The games are launched in online mode by the teacher. The teacher is the game administrator and sets such parameters of the game as the game period duration and the number of players connected to the simulator. To play the games, only computers connected to the Internet are needed. One can enter the game from any device that has an Internet connection. All the solutions entered by the teams are saved automatically.

Only the information for decision making is changed in the periods. The participants get acquainted with the relevant information and work out a variant of budget revenue distribution. Distribution requires doing simple mathematical calculations. The participants enter the sums allocated for each sector in the player space directly, in the period screen. In the first period, the budget size is the same for all the players. In the other periods, the dynamics of all the participants' budget revenue changes are seen. In some periods, players must fill in additional information analysis forms (road map, task recording sheet, etc.). The students fill in the forms suggested in the period screens in their practice books. Schematically, the process of passing through a period can be seen in Figure 1).

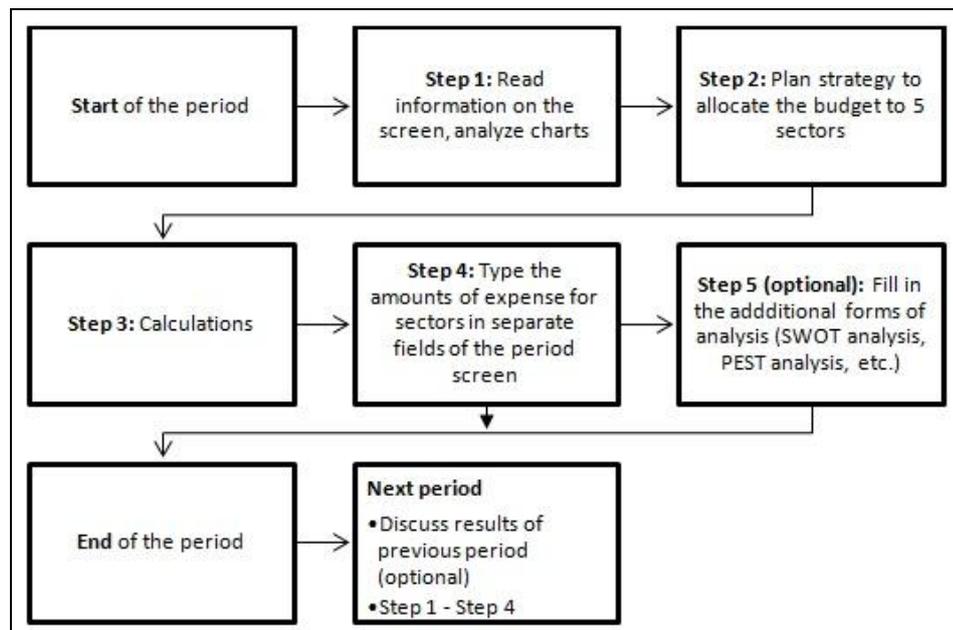


Figure 1: The period flowchart

Data and method

We decided to teach courses using computer-based simulation games to analyze the outcome of implementing games in MPA curricula. We tested the implementation of games in the municipal governance courses for first-year students of MPA programs. This study was

conducted in the National Research University Higher School of Economics (HSE) and in the Russian Presidential Academy of National Economy and Public Administration (RANEPA) in Saint Petersburg.

We used posttest examinations to evaluate the effect of simulation games on students' knowledge of municipal finances. Two groups of students were randomly selected in each university and randomly allocated either to the experimental or the control group. In control groups (n=12 in HSE, n=13 in RANEPA) students had traditional lectures. In experimental groups (n=12 in HSE, n=13 in RANEPA) students played three simulation games in addition to traditional lectures.

A structured questionnaire was used to collect the data. The first part was designed to gather demographic data (age, gender, number in the group, university). The second part was the written examination. The exam contained 20 multiple-choice questions on municipal budget. The questions were taken from several sources, such as textbooks, Internet resources, and official documents of government institutions.

Municipal budget knowledge scores were calculated by correct/incorrect responses. Questions 1 to 10 were about theoretical aspects of municipal finance. Questions 11 to 15 concentrated on financial terms used in official documents. Questions 15 to 20 were about administrative decision techniques. The mean municipal budget knowledge scores were calculated for analysis for each question. We calculated the number of correct responses for each question within each group of students. We compared the average number of correct group responses for the exam (in percentages) to determine the difference between the experimental and control groups in the scores of municipal budget knowledge.

Results

The study sample was distributed almost equally between the genders (female = 27, male = 23). The mean age for the whole sample was 22.3. Results of the exam show several interesting observations (table 1). First, all four groups of students remembered the theoretical aspects of municipal finance at a good level. Therefore, memorizing theoretical material is more connected with lecture time.

Second, both control groups gave significantly fewer correct responses to questions about financial terms that are used in official documents. Students in the HSE control group dealt with this type of questions twice as poorly as students in the HSE experimental group. Students in the RANEPA control group gave three times fewer correct answers than students in the RANEPA experimental group to questions 11 to 15. Therefore, we conclude that the simulators that we developed help students to remember the features of the documents of municipal administration.

We believe this is an essential skill for success in the students' future professional activity. In addition, this is an important indicator of the effectiveness of using computer-based simulation games for learning aspects of municipal budgets.

Third, the experimental groups had more correct responses to questions about administrative decision techniques. Students in the HSE control group coped with this category of questions 63% worse than students in the HSE experimental group. Students in the RANEPА control group gave 75% fewer correct answers than students in the RANEPА experimental group to questions 11 to 15. We conclude that simulation also helps in understanding administrative decision techniques. The study shows that simulation technique is better for that purpose than lectures.

Table 1: The number of correct responses of the groups on each question of the exam test

Theme of the question in the test	#	The number of correct answers on the question			
		HSE experimental	HSE control	RANEPА experimental	RANEPА control
Theoretical aspects of municipal finance	Question1	12	12	13	13
	Question2	12	12	13	13
	Question3	11	11	12	12
	Question4	12	12	13	13
	Question5	10	11	12	12
	Question6	11	12	12	13
	Question7	11	12	12	13
	Question8	12	11	13	12
	Question9	12	12	13	13
	Question10	11	11	12	12
Financial terms in official documents	Question11	12	5	13	2
	Question12	12	6	13	3
	Question13	11	4	12	2
	Question14	11	5	12	2
	Question15	10	6	11	2
Administrative decision techniques	Question16	11	3	12	2
	Question17	11	4	12	3
	Question18	11	5	12	2
	Question19	12	3	13	3
	Question20	11	3	12	1

Overall, both experimental groups performed better on the exam (Figure 2). Students of the HSE experimental group performed better than students in the HSE control group by 27.5%. Students of the RANEPА experimental group performed better than students in the RANEPА control group by 38.0%. We assume that the difference between the control groups is connected with the students' level of knowledge before the course. A limitation of the study is that we did not administer a pretest to check the knowledge of students in HSE and RANEPА. We did not include in a structured questionnaire questions about previous courses. As we discovered,

students in HSE had previously taken a course on government finance. The difference between the performance of the control groups could also be connected with the quality of teaching. However, that issue is beyond the scope of this study.

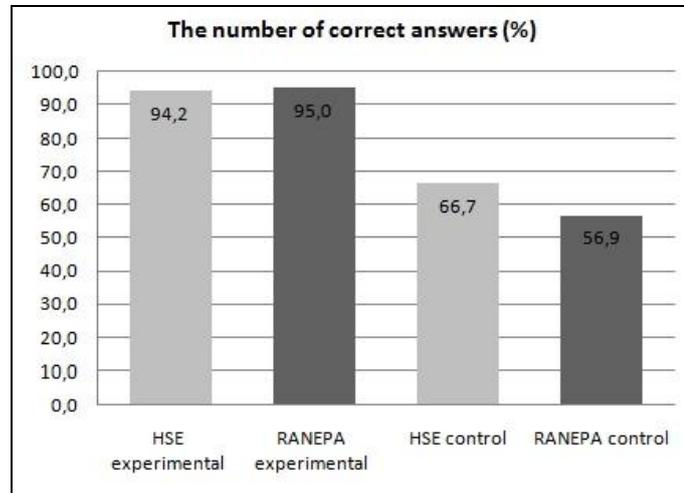


Figure 2: The percentage of correct responses for the exam in the experimental and control groups

Conclusion

Despite this study does some contribution in the research and practice of computer-based simulation games in public administration education, it obviously has some of the limitations. First, these are limitations, which relate to regional and institutional particularities. We have tested only two Universities in the same region (St. Petersburg), and the number of students in the sample is rather small. We can suppose that a different distribution is expected in other Universities of Russia. The second limitation concerns the necessity of having a pre-test survey to understand students' prior knowledge of the subject. A third limitation is due to the fact that we do not have any data which could link to students' experience and engagement which are also very important for the educational process. In the next studies, we are going to measure the students' respond for the usability, interface, digital literacy and other issues concerning some subjective aspects of the computer-based simulation games.

However, in general our study shows that computer-based simulation games on municipal finance for students of MPA programs not only improve their knowledge but also contribute to the gaining of many other skills. Computer-based simulation games contribute to an effective learning process.

References

- Auster, E.R. and Wylie, K.K. (2006). "Creating active learning in the classroom: A systematic approach", *Journal of Management Education*, Vol 30, No.2, pp.333–353.
- Bovill, C., Cook-Sather, A. and Felten, P. (2011). "Students as co-creators of teaching approaches, course design, and curricula: Implications for academic developers", *International Journal for Academic Development*, Vol 16, No.2, pp.133–145.
- Chris, S. (2012). "The Impact of Simulations on Higher-Level Learning". *Journal of Public Affairs Education*, Vol 18, No. 2, pp.397–422.
- Harding, C., Garrett, S. and Wang, S. (2015). "Game-playing and understanding decision-making within legal frameworks: the use of computerised simulation". *Information & Communications Technology Law*, Vol 24, No.1, pp.1–15.
- Hsieh, J.-L., Sun, C.-T., Kao, G. Y.-M. and Huang, C.-Y. (2006). "Teaching through simulation: Epidemic dynamics and public health policies", *Simulation*, Vol 82, No.11, pp.731–759.
- Lengwiler, Y. (2004). "A Monetary Policy Simulation Game". *The Journal of Economic Education*, Vol 35, No. 2, pp.175–183.
- Meyers, C. and Jones, T. B. (1993). *Promoting active learning: Strategies for the college classroom*. San Francisco: Jossey-Bass.
- Weir, K. and Baranowski, M. (2011). "Simulating history to understand international politics", *Simulation & Gaming*, Vol 42, No. 4, pp.441–461.