

APPLICATION OF COMPUTER GAMES IN PUBLIC ADMINISTRATION: LEARNING SYSTEM ANALYSIS AND TECHNOLOGY-SOCIETY POLICIES WITH SID MEYER'S CIVILIZATION

András Nemeslaki¹, László Molnár² and Tas S. Nemeslaki³

DOI: 10.24989/ocg.v335.23

Abstract

In this paper we explore how Civilization, one of the most popular turn based strategy games, enhances public administration (PA) education for entry level students. We pose the research question, how computer games in PA studies can be aligned systematically with curriculum design, and how they make educational experiences and processes more successful than standard teaching. We present an experiment which ran at the National University of Public Service in Budapest during the academic year of 2017/18 written up in a case study format. We describe the learning objectives of the Government Studies program and the objectives of the Information Society and System Analysis courses, where the students had been exposed to playing Civilization. Our findings suggest promising results using computer games in four aspects of PA: a) effectiveness and efficiency of learning, b) implications of advanced technologies in government studies, c) further applications of computer games (different uses of Civilization and others), d) PA problems that can be solved by games and how this idea is being receipt.

1. Introduction

Knowledge and skills in public administration areas have been changing rapidly. There is a more dominant need for analytical, decision making, complex system thinking skills, and especially understanding the implications of technology for social policies. Education of PA is struggling with these issues.

A new generation of students enter PA programs, and already a more ICT astute generation have appeared in PA organizations. The challenge is twofold; firstly, at the output of education they have to understand these new complexities and being able to contribute for PA policies, secondly, at the input phase they have to be addressed with content and methodologies which maintain their educational needs.

In this paper we explore how the application of computer games combined with system thinking and science-technology studies can enhance PA education and contribute to solving these educational challenges. We pose the research question, how computer games at the early stage of

¹ Budapest University of Technology and Economics, Budapest, Magyar tudósok krt. 2., nemeslaki@finance.bme.hu

² National University of Public Service, Budapest, Ludovika tér 2, molnar.laszlo@uni-nke.hu

³ Eötvös Loránd University, Budapest, Kazinczy u. 23–27, tas.nemeslaki@gmail.com

PA studies aligned with systematic curriculum design make educational experiences and the learning process more successful than standard teaching.

2. The role of science technology studies and system thinking in PA education – a theoretical and conceptual review

The National University of Public Service (NUPS) is responsible for educating the future leaders and managers of the Hungarian public sector. NUPS launched a five-year master program in Government Studies with the following objectives:

- educating its participants of the complex knowledge involving the tasks, organization and operation of state,
- to provide skills and knowledge for of systematically handling human capital, and performing high-level planning, strategic analysis and leadership tasks,
- to introduce the concept of strategic planning of public policy and analysis,
- to make students capable of creating government models, and understand the techniques, basic legal and public service frameworks,
- to familiarize students with the techniques of efficient management of the changes in state structure and governance,
- to educate students how to organize government activities using comparative methods and international models,
- to introduce the societal, political, economic and human elements which define and influence the function of government.

The Information Society course of this curriculum introduces the cultural, political and economic issues of the information society and the Internet, and reviews the state responses to this challenge by analyzing some information strategies. The strategic approach of the course is emphasized by presenting the strategic incentives of the ICT companies, so it deals with network and microeconomic issues, as well as the macroeconomic impacts by which the information economy has an impact on national competitiveness.

The Systems Theory and Analysis course familiarize students with the basic terms of cause-effect relations, elements of system thinking, and modeling complex legal, organizational and technological problems (positive and negative feedbacks, effects of delays and externalities, dynamic models, cause-effect diagrams). Students supposed to acquire skills to exploring, analyzing and evaluating basic system archetypes.

In order to methodologically enhance the two courses, the authors initiated the introduction of a well known turn-based strategy game series – Sid Meyers' Civilization. Games, especially strategy simulation games, such as Civilization, are great tools to illustrate system complexity, how and why leaders allocate their resources, and importantly what is impact of technology on social development and vice versa. During the gameplay of Civilization we can observe how nations

expand from ancient times as a result of economic development, geographical expansion, warfare and most importantly as the result of technology evolution.

In the case of the Information Society course Civilization was used primarily to show the dynamic perspective of socio-technical evolution, with Systems Theory course the game was applied for modelling and analysis as well. used test the methods and tools of the subject.

3. Use of computer games in education – experiences in PA education

The potential to use computer games in education has become relevant as their popularity and availability has grown. As the advancements in using video games and simulations for educational purposes in the corporate, government and military worlds have grown a similar change in the world of schools was raised [1]. With the appearance of serious games - games used for purposes outside of entertainment – a vast variety of opportunities have risen [2]. For instance, [3] uses an overview of two gaming based research programs in education to make a case for a gaming based future of education either through the specific use of commercial games, or through gamification and gaming techniques. Another literature review summarizes the effect of video games on students at the age of 14 years, finding links numerous cognitive and other outcomes; the most common of which were the acquisition of knowledge and motivational outcomes [4].

Civilization, is one of the oldest and most widely known turn based strategy games in the gaming industry. Its use in classrooms has been explored mainly in history education for instance discussing how useful the game is in effectively studying alternate historical events [5]. [6] explore the use of a specific lesson plan using Civilization IV to teach world history to ninth grade students in the hopes of encouraging high-order thinking. As [7] reports after experimenting with the IVth edition of the game series, student feedback indicates that the methods used allow many undergraduates to better understand complex historical concepts, as well as form assumptions based on critical analysis of the historical content of the game. Also, it helps children to learn visual conceptualization [8]. Using Civilization in classroom is fun, research proves that the enjoyment factor overrules the conceptual scaffolding, indicating that free flow and creativity is essential when video games are deployed in education [9].

Computer games are also used in PA and related fields. For instance, noteworthy applications are documented by [10] using SIM CITY, or [11] how to use games in politics. There are accounts also how to conceptually integrate games in civil service education [12]. Civilization is used how to learn about power games, and [13] claims that players of Civilization through their play get used to various theoretical tools, such as the concept of cultural, social and economic capital, and how they influence modern social practices and learning process.

Methodologically, most research in the field uses case study based approaches similar to [14], who also give a detailed guideline on how to design and execute research of this kind.

4. Research Methodology

Prior to the start of the course students would be surveyed to form an image of their experience as gamers, their specific experience with strategy video games or the Civilization series in particular, and overall the level of their digital literacy. Based on the information obtained we would then organize the volunteers into groups of 3 or 4, which we would be sure to balance out in terms of player experience. This was important to us as we expected to organize a larger scale multiplayer

event, where the groups would play against each other on the same map. The controlled division of the groups was meant to avoid certain teams getting a clear advantage over the others that would have made the game experience seem unfair. Table 1. depicts how students assessed their skills on a 1 (worst) to 4 (best) scale.

		DigiLit	Games	StratGames	Civ	Willingness
N	Valid	97	97	97	97	97
	Missing	0	0	0	0	0
Mean		2,49	2,76	2,07	1,58	2,61
Median		2,00	3,00	2,00	1,00	3,00
Minimum		0	0	0	0	0
Maximum		4	4	4	4	3

Table 1. Students' skills in digital literacy and gaming

They are assessed their digital literacy skills lower than experience with computer games, but knowledge of strategy games and particularly Civilization had been the lowest.

There has been no correlation between digital literacy, knowledge of games and willingness to participate – basically all respondents expressed interest to participate. Those who already played with Civilization they all expressed strong desire to take part in the experiment.

	S1Group (Semester 1)							S2Group (Semester 2)												
Group Number	1	2	3	4	5	6	7	1	2	3	4	5	6	7	8	9	10	11	12	13
Male	2	2	3	0	2	2	0	2	1	2	0	2	3	1	3	1	3	2	0	1
Female	1	1	1	1	1	2	1	0	2	0	3	1	0	2	0	2	0	0	3	1

Table 2. Group distribution by semesters and genders

Table 2. shows 7 groups in the First Part (InfoSoc), 13 groups in the Second Part (SysAnal), no significant difference in gender or any other variable. There were 19 players in S1 (11 male, 8 female) and 35 participants (21 male, 14 female) in S2.

Courses would be held on a weekly or bi-weekly basis. This would give us a set of regular opportunities to play the game as a group and discuss possible difficulties that arise throughout the semester. The sixth game in the series, Civilization VI, would be the version used in the classroom, but any of the previous games would do for use at home. Limitations of the computer hardware at our disposal meant that the latest game in the civilization series, Civilization VI, was not a reasonable choice. The chosen version then became Civilization IV, the latest of the games that would reliably run on our systems, and the one receiving the some of the best critical acclaim. During the classes the game would be used to provide simulated examples useful in helping the student grasp the otherwise theoretical concepts in practice.

The first class in the Information Society course would be dedicated to the introduction to the game Civilization IV itself. After assigning the students to their respective groups we would begin teaching them the primary game mechanics, making sure that by the end of the first class they

would possess all knowledge necessary to initiate, save and load their own games, to issue commands to their units, manage the production cues of their cities, assign technologies to research, and be able to find any additional relevant information on their own if need be. Assignments would be handed out via the E-learning systems in between classes.

A second class would be scheduled half way through the semester to provide the students an opportunity to address any concerns that arise along the way in person. Additionally, if time permitted, this class would also be used to start a multiplayer game session, where the groups would play competitively against each other. Practicing particular techniques connecting to the course material were focusing on the technology tree and exploring technology, and focusing on decisions, causality, teamwork and generalization.

The third and final class would be dedicated to discussing the completed tasks, and reflecting on the semester as a whole using a group interview format. The discussion would also be focused on gathering feedback to judge the overall effect of the program and to identify areas where it can be improved.

Over the course of the semester the groups would document the games they played and the tasks they completed in journals. These would contain the major decisions made during their gameplay, the reasoning and thought processes behind them, and the effects they had on the outcome compared and contrasted to their expectations. Solutions and answers to the assigned tasks and optionally any desired feedback would also be included in these journals.

The second semester of the course was different in many ways. Some of the limitations on us in the first semester were not present this time around, and we also made several changes based on feedback gathered from the students on our last session. The bi-weekly sessions became a reality this time. During the lecture hours a computer laboratory was made available, allowing us to organize regular sessions. A key difference was a much closer collaboration with the lectures and the connection of assignments with the topics presented during the lectures. Conceptually, the gaming sessions of the System Theory class used Civilization as an illustration for the topic starting with a presentation followed by team discussion and summarizing the previous and the upcoming home assignment.

First class had little difference compared to Information Society: students played Civilization and newcomers had to familiarize with the mechanics of the game. Topics of the second class were system attributes and system control. In the third modelling was discussed along with organizational use: students had to play with “Stanley’s Parable” for demonstrating the limitation of system models and how to apply flowcharts.

The fourth class dealt with system dynamics; students were introduced to the “beer game” and the “Surviving Mars” simulation. In the fifth class MIT’s Moral Machine was brought in and topically students discussed the process of decision making, which was further extended in the sixth session with complex networks. Here two new games were introduced Democracy 3 and Europa Universalis. Finally, in the last class the topic of scale-free networks was covered: here we returned to using Civilization.

In between classes students would be assigned tasks involving further gameplay to complete with their group.

Group assignments were restructured to feature a task list with individual point amounts assigned to each sub-task to allow the students an easier understanding of the weight of each element. We also made the decision to allow the students to form groups based on their own choosing. This was done based on the feedback from the students, where group dissonance was the most common difficulty experienced. New players were more likely to learn the game well if they worked together with others they were comfortable with, regardless of the other players' skills. Groups were only formed by us in such cases where students did not form groups of their own, or where groups did not have enough members. It is worth mentioning though, that these were freshmen students who did not yet know each other well in the first semester.

The product at the end would be a log of the events that occurred in the sessions, with specific attention dedicated to answering questions posed by the teachers.

5. Discussion of results

In Table 3. we summarize the number of students who provided feedback on their learning experience.

	Frequency	Percent	Valid Percent	Cumulative Percent
Valid NOT PLAYED	77	61,1	61,1	61,1
PLAYED	49	38,9	38,9	100,0
Total	126	100,0	100,0	

Table 3. Group distribution by semesters and genders

In the following discussion section we give a general summary of these reports, our observations and juxtaposition of other sources such as colleagues' opinions.

5.1. Effectiveness and efficiency of learning

Attendance of classes varied greatly between the first and second semester. Requirements were different, while in the first term grades were given only based on the homework submission class attendance was not required for all the sessions only two of them had been mandatory. After drawing the conclusions we required the presence of at least one team member to be at the seminars and at the lectures. It was interesting to note, that the 24 seated Computer Lab occasionally proved to be too small and extra places needed to be created.

The 7 Study Groups during the first semester of the Information Society course reported that they enjoyed playing the game and working on the exercises but they did not value the content any higher than the lectures. From the course assessments we know, that our students had a great time in the first semester, but don't get much new information from our alternate method, they gain most of the subject's content from the lectures. During the second semester the 13 Study Groups although still enjoyed the gameplay they had to work on more assignment which were more tightly connected to the topics of the lectures in System Thinking.

The following basic knowledge concepts have been the learning objectives in the two programs:

Information Society

- To understand the impact of technology on society and how technology development is impacted by social developments.
- Technological determinism and diffusion theory.
- Gartner's Hype cycle.
- Social Construction of Technology and technorealism.

System Thinking

- System approach, system attributes, target predicates and decision making attributes.
- Complex cause and casual loop diagrams, modelling, participation modelling.
- Supply-chain management, flowcharts, Critical Path Method, and principles of process mapping.
- Basics of system dynamics and team dynamics.

In summary, the students had to acquire the view points and methodological frameworks of system analysis and technology-society relationship. The key objective was to convey a comprehensive approach to study PA, and to understand how structure determines behavior and results in specific events.

5.2. Technologies

Civilization models the impact of technology on society by using the "technology tree". Players choose the route how they climb this tree, that is in what sequence they explore and deploy new technological innovations. In order to facilitate discourses on the complex technology-society relationships we asked our students to discuss interesting technologies and their potential impact on society. The recommended technologies were included:

Space technologies, new materials, cloning (future based):

- Cloning and Genetic modification: For improvements in military and population control, as well as increasing the quality of life.
- Extra-terrestrial bases: To add the ability to construct bases on other astral bodies for a large boost to scientific research, as well as a great increase in resources.
- Terraforming: To create resource deposits on the map, and to help shape the terrain to the choosing of the player.
- Wormhole theory: Allows fast travel between planets.

- Alternative energy sources: Effects the populations happiness to reflect the reduced environmental impact

Information communication technologies (present, mainstream)

- Nanotechnology: For use in improving medical procedures and furthering scientific research capabilities.
- Artificial intelligence: To improve the effectiveness of mechanical units.
- Automated vehicles: Helps to improve effectiveness of trade and economic growth.
- 3D printing: Helps to reduce production costs in cities, provides cultural and happiness increases.
- LED technology: To reduce power consumption of electronic devices, thus increasing happiness and reducing upkeep costs.
- Retinal scanners: To help provide an extra measure of defense for keeping researched technologies safe from foreign espionage.
- Drone technology: Improves military capabilities and surveillance at the cost of a negative impact on happiness.

Socio-technical concepts:

- Social networking: Effects population growth and the spread of culture.
- Virtual reality: For use in better training military units, with added cultural and entertainment values.
- Universal translation technology: An important tool in aiding relations with foreign civilizations.
- International sports events: Helps to increase the populations health by promoting sports and exercise, as well as provide cultural bonuses to hosting countries.

5.3. Further applications of gaming

In order to collect suggestions from students based on their experiences both with computer games and with their government studies we asked them which other video games they believe could be used for other educational purposes in their program. The following is the summation of the recommended games and areas:

For the purposes of better understanding strategical thought-processes and other similar functions, many of the students recommended the use of other well renowned grand-strategy games such as Crusader Kings, Europa Universalis, or Hearts of Iron.

Various MMORPGs (Massively Multiplayer Online Role-Playing Games), such as World of Warcraft and Eve Online, were recommended to help depict the role of a single individual within a larger coherent system.

Several students recommended certain CCGs (Collectable Card Games) as a way to showcase the importance of risk-management, i.e. how to utilize the tools under our control to cope with random occurrences within the system.

The various games in the city-builder game series Sim City were recommended for use in showcasing causality, the effects that elements of a system can have on the others, and how to create models and diagrams of the process. The Sim City games tendency to showcase city information in graphs and charts was also a reason to suggest these games as a way to improve data interpretation abilities. Other city-builder games were also mentioned for this purpose, such as Banished or Zeus and Poseidon.

The afore mentioned MMORPGs were also commonly grouped together with certain team based tactical action games, such as DOTA 2 (Defense of the Ancients) or Heroes of the Storm, to train in team structuring and communication.

Numerous games of differing genres were mentioned as ways to help understand system characteristics and the ways to control and influence them. Real-time strategy games recommended here included Age of Empires, Starcraft and the Total War series. Survival/crafting games recommended included titles like Rust, Space engineers and Minecraft.

5.4. PA Problems that can be sold by games: reception of the idea

Beyond the learning objectives of the two particular courses students reported other – more general – impacts of the experiment. The groups consisting of three members were introduced to develop teamwork, and reflect in the journals on how they identified together key decision points, assessed alternatives and have come to joint decisions. They reported several learning conclusions and also how these exercises encouraged creativity.

Several feedbacks referred to the fact that after the course it is easier to connect cause-and-effect relationships between the various legal areas, and to grasp how society is impacted as an organic system. This is especially important in central and eastern European PA education which is traditionally employs only the use law and often handles the different legal areas separately barely touching the influence of technology on administrative thinking.

Thanks to our acquired experience and the important feedback from the students our methods during the Systems Theory course in the second semester became much more refined. Due to this our alternative opportunity for course completion became a bolder, more extensive rival to the traditional “lecture path”. Education of the subject proceeded along the same goals as before, that is the broad expanding of PA skills through the use of our method while still teaching the material in the curriculum in an enjoyable fashion.

6. Conclusion

System Analysis and Thinking subjects with Information Society topics in PA education help future leaders to understand complexities of our societies in the 21st century.

In the reported experiment at NUPS we tested the use of the turn based strategy game Civilization to identify the effects technology on society and individuals, so that students become more foresightful and empathetic in the choices they make in the future. Information Society also emphasizes the importance of Systems Theory as shown by the university in the course description. However, in order to demonstrate this to students it is not enough to illustrate how culture and technology affect each other in an information society, or what processes occur within society as a system - they must also understand how the mechanics of these dualities work. That is where believe the main contribution of our experiment lies, especially with the deployment methods and practical tools presented to students. Participating students reported that putting technology and complex system thinking with using strategy simulation concepts at the beginning of their Government Studies program raises not only awareness but also the experience factor of their education.

7. References

- [1] SCHAFFER, D. W., SQUIRE, K. R., HALVERSON, R. and GEE, J. P., Video Games and the Future of Learning, *Phi Delta Kappan*, Vol. 87., No.2., pp. 105-111, 2005
- [2] SUSI, T., JOHANNESSON, M. and BACKLUND, P., Serious Games – An Overview, *Technical Report HS- IKI -TR-07-001*, p. 28, 2007.
- [3] SQUIRE, K. D., Video Games and Education: Designing Learning Systems for an Interactive Age, *Educational Technology*, Vol. 48., No. 2., pp. 17-26, 2008.
- [4] CONNOLLY, T. M., BOYLE, E. A., MACARTHUR, E., HAINEY ÉS T., BOYLE, J. M., A systematic literature review of empirical evidence on computer games and serious games, *Computers & Education*, Vol. 59., No. 2., p. 661–686, 2012.
- [5] BURNS, A., Civilization III: Digital game-based learning and macrohistory simulations., 2002. [Online]. [Accessed 27 January 2019]
- [6] PAGNOTTI, J. and RUSSELL III, W. B., Using Civilization IV to Engage Students in World History Content, *The Social Studies*, Vol. 103.,No. 1., pp. 39-48, 2012.
- [7] WAINWRIGHT, M. A., Teaching Historical Theory through Video Games, *The History Teacher*, Vol. 47., No. 4., pp. 579-612, 2014.
- [8] LIU, C.-C., CHEN, H. S. L., SHIH, J.-L., HUANG G.-T. and LIU, B.-J., An enhanced concept map approach to improving children’s storytelling ability, *Computers & Education*, Vol.56., No. 3., pp. 873-884, 2011.
- [9] CHARSKY, D. and RESSLER, W., “Games are made for fun”: Lessons on the effects of concept maps in the classroom use of computer games, *Computers & Education*, Vol. 56. No. 3., pp. 604-615, 2011.
- [10] KOLSON, K., The Politics of SimCity, *Political Science and Politics*, Vol. 29, No. 1, pp. 43-46, 1996.

-
- [11] MAYER, I. S., The Gaming of Policy and the Politics of Gaming: A Review, *Simulation and Gaming*, Vol. 1. No.6, pp. 825-862, 2009.
- [12] RAPHAEL, C., BACHEN, C., LYNN, K.-M., MCKEE, K. and BALDWIN-PHILIPPI, J., Games for civic learning: A conceptual framework and agenda for research and design, *Games and Culture*, Vol. 5., pp. 199-235, 2010.
- [13] VALDRE, M., Dominance and Security in the Power Discourses: Sid Meier's Civilization as an Example of Discourses in Power-Games, *CEU Political Science Journal: The Graduate Student Review*, Vol. 2., No. 1., pp. 58-71, 2007.
- [14] WATSON, W. R., MONG, C. J. and HARRIS, C. A., A case study of the in-class use of a video game for teaching high school history, *Computers & Education*, Vol. 56., No. 2, pp. 466-477, 2011.