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This videogame is just like my plant!

Abstract

This paper presents a learning experience that was developed using the commercial videogame Rise of Nations for a graduate course on Manufacturing and Operations Strategy. This is a historical strategy game in which players compete by taking civilizations through progressive development stages. The game was employed under the Serious Games paradigm, in which a game is considered serious when it is used with an objective other than entertainment. This paper explains the objectives of the use of the game in the class, the regulations and learning guides that were employed, the experiences the students lived, the main points the students take away from the use of the game and other experiences that take place in the class in addition to the delivery of contents and development of skills. This experience took place at Universidad Icesi, in Cali, Colombia.

1. Introduction

Education nowadays has to concern itself with more than the mere transmission of contents. It has been clear for some time that students must also develop skills and abilities to apply knowledge and concepts to actual work situations.

Educators must build courses that have a variety of learning experiences. These experiences must give students the opportunity to contrast and appropriate the concepts under discussion, in order to be able to use them in their work settings. This paper presents one such course, where different tools (lectures, analysis of videos and videogames) have been employed to make the course more successful. At the end of the course, important realizations emerged from the students themselves, such as the statement that titles this work (“This videogame is just like my plant!”).

The paper is divided in three sections. First, some background related to the use of games is presented in section two. Then, the course itself, its theoretical contents and the use of the videogame are discussed in section three. Finally, the impact of the game and the transfer of its metaphors to work situations is presented in section four. Some conclusions and future research ideas close the paper.

2. Background

In this section we will present some background related to Serious Games (and their educational use) and the specific game employed in this course, Microsoft’s Rise of Nations.

2.1. Serious Games

The term Serious Game is attributed in the literature to Clark Abt¹. In his book titled Serious Games, Abt presents the idea that games could be used for educational applications. When his book appeared first, he was referring basically to board and card games, since video games and other forms of electronic games had not been invented and popularized yet.

Serious games have evolved since their formal inception, and have been used in a wide range of settings with a variety of applications. There are multiple references of the use of computer and video games for military, educational, public policy, health care and corporate affairs, as well as mathematical and languages education (Breuer and Bente², Johnson, Wang and Wu³, Brezinska and Hovestadt⁴).

Two types of games that were widely discussed at one point are Edutainment (Education plus Entertainment) and instructional computer games. However, their acceptance in the academic community has been less than warm because they emphasized drills and repetition, a form of education that does not develop higher-order cognitive abilities, and they did it with game activities that were not attractive to students (they were not entertaining, Mayo⁵). Games that were nothing more than a sequential delivery of contents through computer animation and multimedia materials emerged, as well as computer assisted course management systems (with functions similar to courseware systems such as Moodle or WebCT) disguised as games were two incarnations of serious games that were not very successful. These two last examples required students to play during class time, but they did not show any interest in continuing playing outside class hours. Because of this, these games depended strongly on the physical presence of the instructor. In the end, what was conceived as an opportunity ended up being no more than an appendix, and the instructor had to resort back to the blackboard.

If a game is not attractive to students, they will not play it and hence the learning objective cannot be achieved. This is why in recent years entertainment has been considered an integral part of any Serious Game, whether it is conceived as a commercial enterprise to generate sales or as a purely educational pursuit. For example, employing a game to keep a person entertained and focused during a surgery, or to keep a child from moving and getting anxious during a visit to the dentist were also considered valid serious games. All of these examples reinforced the idea that entertainment did not hinder learning or any other objective pursued by a game; all the opposite, providing good entertainment enhanced and made more effective the achievement of any other objective a game might have.

We contend that, even though a game was not designed specifically to be used as a serious and educational game, it can be made a serious game by applying learning guides and rules that emphasize specific aspects of the subject matter being taught and the abilities that the instructors want the students to develop. A game can be made serious if it is used in a serious, structured and purposeful way.

2.2. Rise of Nations

Rise of Nations is a commercial videogame published by Microsoft. This game was not conceived for educational purposes, however, its characteristics as a strategy game with adversarial relationships, competition for resources, winners and losers and fast-paced action that compresses time are advantageous for its use as a structured learning activity that retains a lot of its entertainment value (Van Eck⁶, Charsky⁷). Figure 1 presents a screenshot of the game. Figure 2 presents a nation (Chinese) defending their cities against an enemy attack.



Figure 1: Screenshot of a Classical Age Aztec City
(image from <http://www.microsoft.com/games/riseofnations>)



Figure 2: Information Age Bomber Attack (image from <http://www.microsoft.com/games/riseofnations>)

The game is played by several players on a network of PCs. Each game has a limited duration and a clear winner. Each player has to make a civilization evolve and develop, with a certain territory and resources to begin with. The game then advances through historical ages, in which new resources, technologies and weapons become available as the each player’s civilization progresses. The way in which each player chooses to use their resources, to develop technologies, buildings and wonders (a unique kind of building that generates strategic advantages) determines how quickly they reach certain stages of development. At a very early stage players notice that in order to thrive and succeed, their civilizations need to compete with each other for resources and territory, so their development and war strategies become very important in order for them to survive and win the game.

It is necessary to go through two or more processing stages to transform resources into usable raw materials. Players need to gather, process, store and distribute resources, and to keep an inventory of them to be able to generate more complex products, such as technologies, military units, buildings or wonders. Resources need then to be connected to make complex products feasible. Centers of production, storage and distribution need to be strategically placed to generate maximum advantage for the player. Large investments must be made with strategic vision to enable the development of certain technologies that will be critical for upcoming stages of the game. All of these characteristics make this game an interesting vehicle of metaphors for professionals who work in the operational side of businesses.

Rise of Nations was selected for this class because it is possible to intervene and control several critical aspects of the game. Other games with similar aims are usually closed, and the players participate under predetermined conditions. Rise of Nations has configuration options such as the selection of available civilizations, the design of the terrain maps on which the game will take place, the availability of resources and final victory conditions that make it possible for the instructors to exert a concrete and directed influence on the matches, as well as forcing the players to work under specific conditions and demands. Figure 3 presents a tree where each path represents a different type of match.

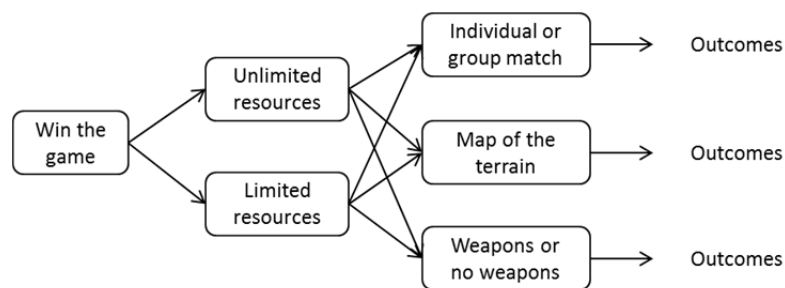


Figure 3: Choices available in Rise of Nations

As an example of this control options, the most common road to victory is for a civilization to develop technology and weapons powerful enough to destroy the adversaries. However, it is also possible to configure the game to exclude arms development as a path to development. This path was experimented (per the students’ request) on a different class (related to environmental management), and under these circumstances civilizations followed a very different path to the

information age and the utopian conditions reached were materials for intense discussions for those other students.

3. The class (graduate level Manufacturing Strategy)

This paper refers to the experience of using a videogame in a Manufacturing Strategy course. This class is a mandatory subject in the graduate Specialist degree in Manufacturing Management. We will explain briefly the structure of the course and the use of the game as an educational tool.

3.1. Course Structure

The Manufacturing Strategy is a 24 hour course, presented in six four-hour sessions. It aims to convey the importance of strategy in any enterprise endeavor, especially focused on manufacturing companies. Different schools of strategy formulation are introduced to the students in a progression, moving towards schools that are currently in use and present a higher degree of sophistication. The strategy schools discussed are:

Fixed Position Strategy: Strategy is seen as the construction of a unique and valuable position, recognized by clients and final users, encompassing the activities required to perform well in four distinct dimensions, known as *generic strategies*:

- Cost Dimension: The capability of running low-cost operations for expanded or contracted markets.
- Quality Dimension: The ability to develop products with superior and consistent quality.
- Time Dimension: The logistical ability to deliver with speed, to bring orders to customers quickly, and to introduce new products on a timely fashion.
- Flexibility Dimension: The personalization of the product, product family variety and volume flexibility.

Based on these dimensions, a dialogue is initiated to bring the operations professionals to configure their production systems to support the unique and valuable position the company wants to maintain. For example, the company can offer low-cost products to mass or niche markets supported by quality, product design and process engineering programs. The different forces that intervene are considered, applying Porter's Diamond⁸. This model studies new competitors, substitute products, the power suppliers hold over the company and the power of negotiation of the customers that constitute the commercial channel. The analysis of these variables allows determining the degree of competitiveness the company has, and the productive process defines in part the competitive ability of the firm.

The in-class discussions are complemented with the discussion and analysis of a video documentary of the Battle of Waterloo. In this battle, Napoleon lost to the Allies. The students and instructor discuss the battle elements and the fixed position strategies implemented by the generals in the battlefield, as well as the decisions that were successful and the ones that were not at the specific battle moments when they happened. At the end of the class students draw metaphors from the battle and transfer them to situations and contexts that happen commonly in business when companies face each other for the conquest of a specific market.

The operations professional needs to design a strategy that enables the company to build a unique and valuable position through the cost structure of the organization, where the productive process usually contributes with 50% of the costs. Also, production processes can be used for differentiation through design, quality and service, rooted in the product development cycle.

Strategic Architecture School: The main proponent of this school is Gary Hamel⁹. In this school, the leader of the company is also the builder of its own scenario to understand the environment. Leaders need to understand the context where the company operates. They gather business intelligence for their economic sector through interviews to experts, statistical market information, testimonials and other sources. As data are gathered, a landscape of the market of interest is built to enhance the leader to “climb the mountain” and achieve a better outlook. Having a suitable perch to observe the market context will enable the leader to fulfill the three phases of the Strategic Intent Process:

- Specify the Strategic Intent: A strategic vision should tell the company where it is headed, a specific direction for the long term. It should also differentiate the company from others and have the capacity to motivate employees and unite them around it. Hamel calls these elements Direction, Discovery and Destiny.
- Set Challenges: Leaders should motivate employees through knowledge and credibility for rational support, as well as appeal to their emotional side. Having both components working in the same direction for the goals of the organization will enhance the achievement of these goals. Leaders should pose challenges and goals that employees feel exciting, worthy and motivating.
- Make the Strategic Intent happen: The strategic intent in a company involves all the employees. It is necessary to build the right organizational structure, to choose the right personnel profile and the right people, and to define the activities, plans and projects to turn the Strategic Intent into reality.

Operations professionals will need to provide company leaders with a clear picture of the company’s capabilities in terms of technologies and their innovations. They will need to find challenges that serve the deployment of the corporate strategies in ways the operation’s employees find interesting and engaging. They will explore new areas of operation and knowledge that take advantage of teamwork and shared technical expertise. They have also knowledge of the rhythms and cycles of technological change, which they can apply to decisions related to product innovation.

One of the additional resources employed in the class is the analysis and discussion of a video related to the Battle of Midway, a World War II naval battle between Japan and the United States. In this battle, the innovative use of aircraft carriers redefines the scope and impact of naval forces and the battles they can present. This battle lends itself for analysis because a new and previously unknown weapon (and a wide host of technologies that came with it) changes the way to wage naval war. Distance, coverage, spheres of influence, projection of power, speed of attack and many other factors in a battle change substantially, and the students and instructor extend these metaphors to the world of business operations, analyzing how new (and potentially disruptive) technologies and forms of operation can be used to gain market advantage for the company.

Recent schools of strategy: In this part of the course, the students and the instructor discuss schools of strategy that are somewhat more recent; that have come into focus because the speed of change and information exchange has increased greatly, and that document and formalize successful experiences by different companies that did not fit into the mainstream schools that were discussed previously. Some of these new schools are:

- Coopetition: Companies have discovered that they do not have to compete in all aspects of business all the time. Some skills and technologies can be developed better and more quickly taking advantage of the complementary nature of the participating companies. Each of the participating companies takes the developed technologies and applies them to bring their own competing products into market. Sometimes these principles are formally applied through “precompetitive” associations or organisms. In essence, this makes more efficient use of resources, promotes cross-pollination between companies and encourages competition because all the participating companies will try to introduce the best product incorporating the shared technology. Collaboration between companies fosters the development of synergies, which bring about more productivity and efficiency in the development of a product for a certain market, looking for a win-win situation for the participating companies.
- Strategic Rhythm: Long-term fixed plans are considered too rigid. Instead, a group of experts from different disciplines and areas of the company is assembled to monitor the competitive environment continuously and adjust operations and business decisions accordingly. This strategy related approach was applied with more noticeable impact on Internet-based businesses. Also, global couriers (UPS), large retail establishments (Wal-Mart), and booksellers turned diverse (Amazon.com) employed this approach. The process of creating goods and services was under global pressure with requirements from different places and countries; it was clear that the ability to adapt to permanent change was a vital necessity.
- Blue Ocean Strategy: Instead of competing for a position in an existent market, create a new market by offering new products and concepts that are not available yet. Instead of fighting in a crowded space, move to one side and create a new space for your company to thrive on (Kim and Mauborgne¹⁰). The process of innovation with this strategic approach again falls in great measure on the operations professionals, taking them to consider new frontiers by proposing non-explored options.
- Global Warming, Climate Change and Resource-Constrained business environments: The limitations on resource availability, the need to find new sources of energy, the rise of the sea levels due to melting of glaciers and polar ice caps make the environment, the use of resources and relationships to communities are critical components to the success of companies. Customers not only appreciate a good product, but demand that the companies that produce them behave like a responsible corporate citizen. This changes the strategic decisions and their deployment into operations’ imperatives. Operations professionals have to develop new systems that use energy from cleaner sources, that do not generate residues, that function in closed cycles, that use less water and generate less greenhouse gases. These challenges have to be addressed through strategies that deliver real results.

In this module, the students and instructor discuss three videos: “*Stomp Out Loud!*”, in which the musical group Stomp creates an interesting spectacle of rhythm, sound and choreography based on non-traditional elements, such as brooms, garbage cans, storage drums and basketballs; the

commercial movie “300”, in which Spartan soldiers coordinated their work as a single body and ultimately failed only when a traitor told their enemy their one weak position; and “*An Inconvenient Truth*”, the climate change documentary by Al Gore. The main metaphors from the movies that students transfer to their operations work are that change is constant, and unless a company is prepared to deal with it permanently, somebody else will come to take their position in a market.

The idea of using a videogame in class arose during conversations between two of the authors (the instructor of the class, who is a business major, and another one, who is a historian), to try to bring a more experiential element to the class, which was entirely based on things somebody else (not the students) was doing and living. The game was seen as a tool to bring strategic decisions and experiences closer to the student.

3.2. Use of the game in the class

The game Rise of Nations® by Microsoft is employed during separate sessions (not included in the lecture hours). Each of the schools of strategy is supported by a workshop with the videogame to reinforce specific contents. The videogame is very dynamic and fast, which makes a good experiential tool to complement lectures and videos. There is not a lot of time to discuss and conceptualize during the game, so concepts and abstractions are discussed afterwards, also with the benefit of hindsight. Players take a lot of the expected behaviors (complete the actions required to win), but also some of them take actions that do not lead them to victory but leave them satisfied with the learning experience (more on this in the next section). The use of the game is divided in five sessions (games or matches), where the first three matches are meant for Immersion, which is the incorporation of the rules of the game and the development of functional activities to achieve the stated objectives. The last two sessions are conceived to apply the rules and activities learned to more complex scenarios and strategic applications. Each match builds on the previous one, with an increasing number of objectives pursued and more complex interactions expected. The overview of the five sessions follows.

Session One: What is strategy?

- Game Task: Individual play (no teams, maximum eight players on a match), play to win.
- Game Objectives: To identify units, buildings, and resources. To develop an initial interaction of the player with the game to build a repertoire of activities valuable and known to the student.
- Match Conditions: Limited resources, one on one competition (each player controls a civilization; there is no cooperation between civilizations). Each player familiarizes themselves with the controls and conditions of the game.
- Theoretical Contents (main learning): Planning is complex, it involves the comprehension of many variables and their holistic application around a common objective.
- Visible Evaluation (common result in gameplay): Students identify the units they control, and though they do not always learn how to move them yet, they understand their function.
- Expertise Gap Dissonance (what happens when some players have more game skills than others): Some players learn to erect buildings faster than others. However, the

construction of the civilization in this match usually occurs individually, rather than socially.

This first match assumes that not all students have experience with this type of videogames (which is always true). Therefore, much of this match is designed to gain familiarity with elements of the game such as units (the little humans that can be assigned to different tasks), buildings, and functionality of the units to manage resources. It has also been observed that students achieve this familiarity faster if a map with uniform terrain (with as little variety and obstacles as possible) is employed.

Session Two: First Model: Fixed Position Strategies. The game is oriented towards one single stable objective, all its variables are geared towards a unique process (winning a match).

- Game Task: Individual play (no teams, maximum eight players on a match), play to win.
- Game Objectives: Articulate units, buildings, and resources with technology management. To multiply the productive basis of the civilization, to advance in the control of the terrain, to understand technology as a sum of resources and abilities.
- Match Conditions: Limited resources, one on one competition (each player controls a civilization, there is no cooperation between civilizations). Each player begins to evolve and develop game-specific skills.
- Theoretical Contents: Strategic planning involves sustainable and gradual growth and the diversification of productive activities.
- Visible Evaluation: Players place units and displaces them at will. Players gather resources in more than one city. The initial city concentrates the majority of the buildings.
- Expertise Gap Dissonance: Experienced players build distinctive buildings, aims to comprehend the growth of the area under their control. Players consolidate their identities in terms of the use of the screen and the information on the maps presented.

Players start learning the impact of time on the game: They have to achieve the evolution of units and buildings to attain the objectives of the game.

Session Three: Second Model: Strategic architecture and innovation. Two groups with a similar technological level face each other; they have flexibility in their management of the resources.

- Game Task: Individual play (no teams, maximum eight players on a match), play to win. There is not enough trust amongst players yet to introduce team play.
- Game Objectives: Change of the scenario, involving mobility and new sources of resources (new resources and technologies can be developed through the combined use of pre-existing ones).
- Match Conditions: Limited resources, two player teams, teamwork and synchronization with the teammate are critical and force discussion of the processes and objectives amongst them.
- Theoretical Contents: Expansion of infrastructure might be required to build an advantage (players learn to replicate buildings in different parts of their terrain). Competition involves many variables interacting in real time (resources are transformed into units at different speeds). The synchronization of processes builds the shared perception of context.

- Visible Evaluation: Players collect resources in more than one type of unit. Players invest units in military pursuits, using groups of the same types of units at first.
- Expertise Gap Dissonance: Some players focus on continuing the development of cities (concentrating all the infrastructure on a single city), collecting large amounts of resources but failing to re-invest them in more unit. Some other players expand their maps and deploy specialized units that can be considered innovative.

In this session, the social component of the game transcends competition (present since the first match) and incorporates cooperation, which enables real-time discussions. Teams focus on what to do differently to overcome what other teams are proposing in the terrain. Roles are differentiated: One team member recognizes the environment; both discuss which course of action to take and the more proficient player implements them on the “board”.

Session Four: Third Model: Strategic Dissonance. In this match players consolidate the relationship between images, units and resources, and incorporate this comprehension in the portfolio of available actions. Units acting in a combined fashion form a lasting image in the mind of the players that guides them during the match.

- Game Task: Team play (paired teams). Still eight players to a match, now organized in two-person teams. Each team competes for victory, but specialization of activities and coordinated gameplay are indispensable.
- Game Objectives: Center the images of the game on the assimilation of contents. Integration of the players when they place themselves in relationship to others to achieve common goals from diverging experiences.
- Match Conditions: Limited resources, teams of two players, teamwork and synchronization with the teammate are critical and force discussion of the processes and objectives amongst them.
- Theoretical Contents: Geographical dispersion demands more careful resource management. At this stage, players could have replicate buildings in more than three cities, with more separation than in previous levels. Complexity and resource assignment in more than one facility are paramount subjects in this match.
- Visible Evaluation: Unit formations are more diverse, but they are not sustainable in terms of the resources that support them because they are devoted to concrete actions.
- Expertise Gap Dissonance: Even though all players can identify units now, skill affects the precision in the use of units. The most skilled player exerts a stronger influence on the team’s actions over the combination of the units projected.

This match emphasizes speed and encourages teams to be more aggressive and innovative, as their grasp on the use of units and buildings improves. Information flows more freely and the pace of the game picks up. At this point, it is also interesting to note that some players do not mind much winning or losing, they may consider a losing match a success if they learned to use their units in a certain way, to coordinate an attack over an opposing team and to use a certain weapon, or to interact in a more efficient way with their teammate.

Session Five: Fourth Model: A Cooperative Model is studied. Its purpose is to highlight complementary actions with the aims of developing a shared comprehension of a complex context.

- Game Task: Team play. Still eight players to a match, now organized in two-person teams. Each team competes for victory, but specialization of activities and coordinated gameplay are indispensable.
- Game Objectives: Players must synchronize management of resources and the deployment of units to ensure the coverage of all the relevant territory, that is, the area that could lead them to defeat if they do not control it.
- Match Conditions: Limited resources, teams of two players organized according to their skill levels and their expertise in the deployment of units. The map of the terrain for this match requires the use of all available units. A tighter connection between units and resource management is present. Players need to consider the whole map for a correct development of strategy.
- Theoretical Contents: Known resources have to be maximized by adequate management of technologies and buildings. If the whole map is not considered, resource management will not be sufficient, therefore making teamwork indispensable. Teamwork is not only prescribed by the workshop; it consists of the synchronized and complementary deployment of units. Also, the time dimension is more critical because teams have to mobilize units to specific places on the map to perform specific tasks. This workshop leads to a division of work, where the less skilled player can be assigned specific-purpose tasks.
- Visible Evaluation: Players deploy units in formations, even units with which they are not entirely familiar. An assessment of teams performance shows that, even though there are units in geographic dispersion, some of them have idle times when they are not performing their expected task.
- Expertise Gap Dissonance: The most experienced player concentrates great firepower (a multitude of diverse units in a limited space). The player with medium expertise deploys different types of units dispersed, with ample spaces between a unit and the next one.

This last match brings teams to a more intense friction amongst them. Territory is rapidly taken by teams and limited resources exert a heavy burden on the teams.

4. Class results and student experiences

4.1. Relation between matches and schools of strategy

Figure 4 presents the general path of the matches, advancing in the axis of school of strategy and increasing the size of the teams. The game is not a strategy simulator, in which the companies and their decisions can be observed directly. Rise of Nations is a historical strategy game, and its use in a class related to operational strategy relies heavily in metaphors. However, the very same condition of not being a “corporate” type of game makes for additional advantages, because players have to abstract their findings on the videogame and find the application to their daily jobs. It is analogous to team building or creative thinking workshops, where participants do not

work directly on their day-to-day problems, but the outside-of-work experience is a vehicle to develop new ways of facing recurrent issues in their jobs.

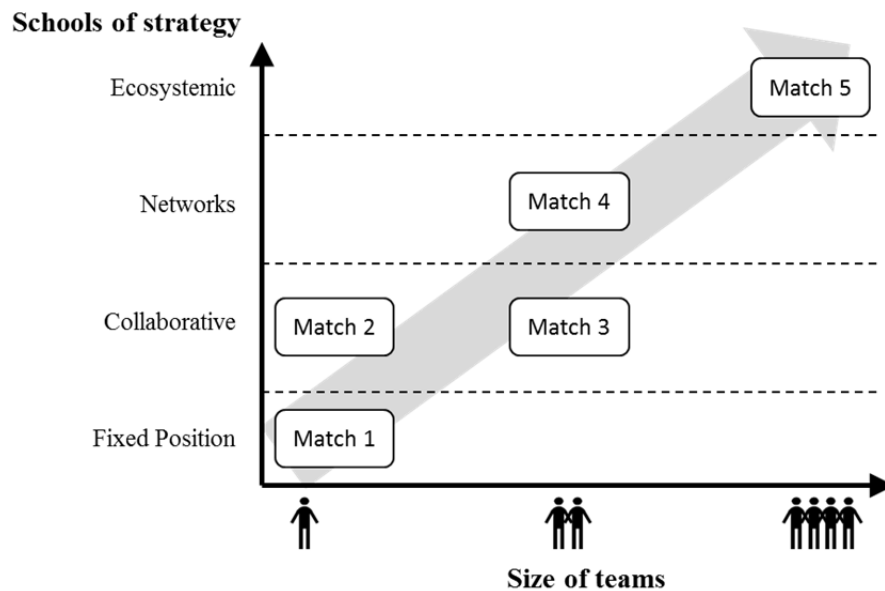


Figure 4: Relationship between team sizes, strategy evolution and game matches

4.2. Evaluation and student experiences

The use of the game was a first experience for this specific course. However, the class had been previously taught by the same instructor. The instructor observed that in the first semester of using the game in class, the quality of the final class reports and the responses in the final exam were better than in previous semesters. It is, of course, necessary to gather more evidence in time and also to develop assessment tools for the strategic thinking capabilities that this class is aimed to foster and enhance.

Students highlighted several positive aspects of the class experience using the videogame:

- The game helped them to develop a wider vision of their work and the field of competition. When an operations professional is focused on their work, it is easy to lose sight of what the competition is doing. The game forces them to consider not only their ideas, their moves, and their results, but also to take into account that their success depends not only on them but on what is happening in their competitive market and what their adversaries are doing.
- Also, the game gives them opportunities to consider the hurried pace of real time, the pitfalls of not planning for the future when they are successful in the present, and the need to connect the needs and moves of all the players to the possibility of all of them succeeding.
- Strategic thinking requires the ability to detect systemic structures, the interactions between system components and the ability to anticipate other player's behaviors. The game presents them with opportunities to work on the development of these abilities through the increasingly complex matches.

- The game is also a good platform to work under unforeseen circumstances; to learn how to deal with the unthinkable, the disastrous, and even the absurd. The students commented on how even the most thoroughly thought-out plans can go awry due to natural disasters or unforeseen technological or regulatory changes.

Finally, from the instructor’s point of view, the game helps the course to widen what he calls the “*amplitude of the discussion*”. This refers to the variety of issues considered during class discussions, the richness and complexity of the systemic behaviors uncovered, and the quality of the strategic thinking the students display at the end of the course. This evolution is presented in Figure 5.

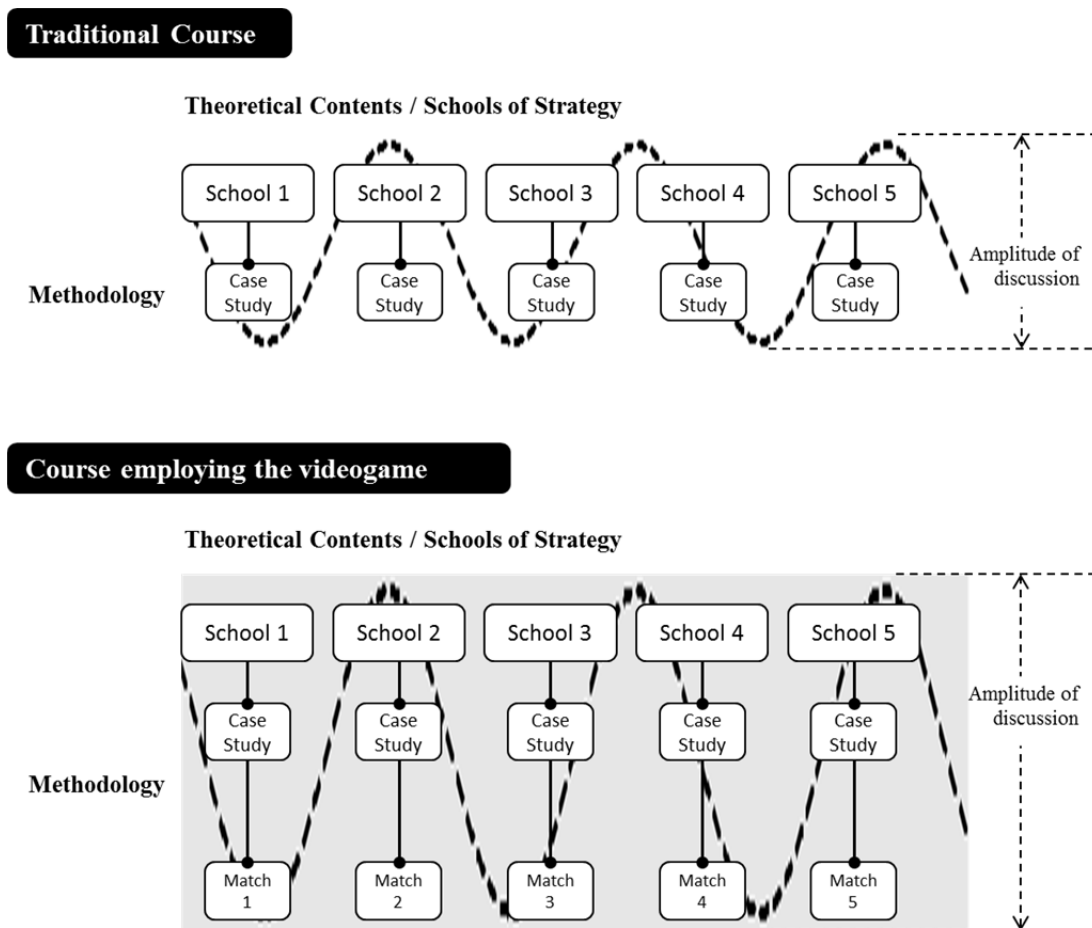


Figure 5: Amplitude of discussion before and after introducing the videogame to the class

5. Conclusions – Metaphors – Learning Situations

At the beginning of the course many students have a hard time relating the activities related to the videogame and the actual content and concepts discussed in class. Some enthusiasts do not care much about it at first, because they enjoy playing this type of games. As sessions progress, it starts becoming more evident for the students that they need to develop strategic and systemic

thinking in order to succeed in the game. Towards the end of the course, students are able to abstract and synthesize their learning experiences in the game and transfer the metaphors from the game to their work situations. Some of the more relevant learning comments received are presented next:

- Professionals in manufacturing areas need to have a wide outlook on situations, circumstances and responses required from them in daily operations. They need to be open to change courses of action and decisions continuously, and to re-assign employees and functions depending on the goals that have been attained. Basically, they need to handle and process information from a variety of simultaneous sources, and in the game there are seven areas of information presented to the player and updated permanently. *The rapid pace of change in the game is a metaphor for the rapid pace of events in a manufacturing setting.*
- Manufacturing professionals have to balance the requirements and plans to be executed to deploy the company's strategy, and to do it while using resources efficiently. These professionals develop a sixth sense to come up with alternatives, contingency plans and immediate and lightning-fast search for additional resources, due to the permanent variability in the operations context. *In the game, players face permanently resource shortages that force them to choose wisely their use and application.* Players need to balance the events of the game happening right now with the longer-term planning outlook required to achieve final victory through the evolution of their civilization. An interesting aspect of the game is that advanced resources and technologies are developed by their own assignment of units and the courses of action chosen, *which is also a metaphor for R&D and learning activities.*
- Companies face competition from many sources. Markets change, rival companies start attacking our market positions, and companies build new plants to offer innovative products. In the game, competition is evident and fast-paced, and since the most basic resource is territory, it can be interpreted as a metaphor for market space. *An interesting parallelism between market share (in the real world) and territory (in the game) is that players cannot take territory directly; they have to gain access to it through the assignment of resources and the development of technologies.* In the same way, it is not enough to wish to gain market share, companies have to build better products, distribution systems, cost structures and support systems to gain customers and convince them to buy their products.
- Every manufacturing plant needs to have a balance between technology and people. Skills and abilities must correspond to the type of process performed and product built; to the technical complexity of the system, and to the social and cultural context of the region where the production process will take place. In the videogame, players must select a culture at the beginning of a match, which has its own characteristics in terms of strengths and weaknesses. These distinctive characteristics become evident during the game. *In this way, culture selection is a metaphor for the technological and human context in which the manufacturing plant operates.*
- Operations professionals must build synchronized systems in their production plants. People in different technological teams must have different profiles and skills in order to operate the system. In the game, each match presents technologies that must be selected and developed in order to advance the corresponding civilization. The player (as well as

the operations professional), must follow closely the events in the game in order to balance the use of resources and to achieve a “*synchronicity effect*” in the match to achieve the stated goals.

- People who work in production plants face planned decisions (governed by those business circumstances that were foreseen), and unexpected events that demand from them quick reactions and adaptations to the plans. Abstract thinking, with high levels of flexibility, is a condition to succeed in operations-related functions. The game Rise of Nations is a dynamic system, with permanent change as a condition. It presents players with ever-changing conditions, product of decisions made by other teams. The game helps players to strengthen their abstract thinking to decipher the unplanned events presented to them and to choose a course of action that takes into account the *now* of the reaction and the *future* of the plans already drawn.
- Students have had favorable reactions to the use of the videogame in class. Three main types of reactions have been found: The student who had already played historical strategy videogames, who enjoys their use in class and understands rapidly what is required to win; the student who is new to the game but quickly adapts and understands the metaphors the game brings to their day-to-day work in operations, and the student who uses the game just because they have as part of the class.
- Finally, a production plant is part of the bigger system that is the organization at large. Organizations are composed of many areas, divisions and departments as accounting and finance, administrative affairs, human resources, quality, and so on. In the game, players must coordinate a variety of activities to move towards victory. In this way, *the game becomes a metaphor for systemic management, considering technological developments, resource gathering and production and assignment of tasks.*

5. Future Research

Videogames such as Rise of Nations might have a variety of applications in educational settings. At Universidad _____, the game is starting to be employed in graduate and undergraduate classes such as *Systems Thinking, Management of Technology and Innovation and Logistics*. New workshops, activities and learning guides are being developed and emerging behaviors are starting to show. All this body of work is being systematized to detect trends and best practices to apply games depending on the contents and skills to develop.

Another avenue of research is to study the evolution of players during the semester, in terms of the depth of their understanding, the relationships they build, the social constructions that take place and the complexity of their thinking. Concepts such as Immersion, Connections, Inversion, Ruptures, and Proximities are being formalized to express and standardize the stages that players go through during the semester.

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