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Lise Urbaczewski
University of Michigan - Dearborn, liseu@umd.umich.edu

Samantha Kleitsch
University of Michigan - Dearborn, skleitsc@umd.umich.edu

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TETRIS AS A TOOL TO TEACH PROJECT MANAGEMENT AND DECISION-MAKING SKILLS

Lise Urbaczewski
Department of Management Studies
University of Michigan-Dearborn
Dearborn, MI, 48126
liseu@umd.umich.edu

Samantha Kleitsch
Department of Management Studies
University of Michigan-Dearborn
Dearborn, MI, 48126
skleitsc@umd.umich.edu

ABSTRACT

This paper describes the use of a popular computer game, Tetris, to help teach and reinforce key project management concepts and decision-making skills. Project management and decision-making objectives tend to be taken for granted with students not truly able to grasp key concepts. To remedy this, Tetris is played with comparisons made to project management and decision-making including analysis of decisions under duress. The use of Tetris as a teaching tool has increased the ability of students to comprehend and apply these skills. Future research measuring true effectiveness is briefly described.

KEYWORDS

Project management, decision-making, teaching tool, Tetris.

INTRODUCTION

One of the roles of academia is to help prepare students for work in society (Brown and Knight, 1995). A challenge in academia has been to make the connection between the classroom and what the students feel comfortable with, and then being able to apply this to real world problems. Project management and decision-making may look quite simplistic when merely reading a book on these topics yet when applying the concepts students quickly observe the many challenges they can encounter. Today, digital media tools are in abundance and many students are comfortable with utilizing these tools as well as spending free time playing video games. Why not then use a classic video game to help students understand some of the challenges they will encounter with overall decision-making? This paper discusses using the game Tetris as a teaching tool: playing the game a number of times and comparing how their decision-making is affected; recognizing that their initial strategy changes as the game progresses; and discussing the parallels as well as differences between Tetris and project management skills. Student observations are also presented to demonstrate the impact that a tool of this type has on providing a base understanding of key concepts.

PROJECT MANAGEMENT AND DECISION-MAKING OBJECTIVES

Project management textbooks in general map out the various tools that assist the project manager in balancing the triple constraint of scope, time, and resources (Atkinson, 1999). Planning tools are emphasized, along with instruction on project preparation, risk management, and other ancillary areas. To the novice textbook reader, project management may appear to be simply a lot of details that are well organized. So then why can't a well-organized project simply manage itself? What textbooks really are unable to communicate is uncertainty: what happens when resources are not available as scheduled? As the schedule progresses and the deadlines approach, how might that affect (or cloud) decisions? Does strategy change over time due to these changes and stresses?

Students tend to take decision-making for granted (March and Heath, 1994). Most students do not consider that there is an actual structured approach to decision-making, rather "it just happens" (DeFranco, 2008). Decision making is a structured process beginning with definition of the problem and intelligence gathering; selecting alternative options; making the decision; implementation; and last, review of how effective the decision was (Cervone, 2005). By understanding the decision-making process, students are better able to analyze what needs to be decided and objectively determine their goals, all with the hopes of then reaching a more accurate and thus better decision. Students also are not usually aware of the simple act of making the decision and its impact. For example, what is the impact of a slow / delayed decision or even no decision at all?

WHY TETRIS?

Tetris was originally designed and programmed in 1984, by Alexey Pazhitnov. The Tetris game is a popular form of tetrominoes (Jordan, 2009). The game is a classic, and is available for nearly every model of computer operating system, gaming system, and mobile device. It consistently is considered one of the top "Greatest Video Games of All Time", thus the majority of the public is well aware of this game. (Kesten, 2007)

The game consists of a random sequence of tetrominoes (four square blocks arranged in a variety of ways) that "fall down" the screen. Players can manipulate the shapes by moving them sideways or rotating them. The objective of the game is to create horizontal rows of blocks without any blank gaps (Guttman, 1996). When an entire row is created, it disappears and blocks above the now deleted row will fall. With every ten lines that are cleared, the game enters a new level. With the advancement of each level, the shapes fall faster and the game ends when the stack of tetrominoes reaches the top thus being unable to manipulate the shapes any further to complete rows.

In Tetris, scores are tabulated by the number of rows completed, the level, and overall score. A larger amount of points are awarded to the score when multiple lines are completed at the same time. This all affects the strategy of the players, as one may strategically leave certain areas of the playing field empty hoping for that ultimate piece to gain more points (Kostreva and Hartman, 2004). In some versions of the game, the ultimate "game over" is completing 15 rows. In the case of the version of the game used for this study, there appears to be no maximum number of rows, thus the game could go on forever, as long as the blocks did not reach the top of the playing field.

TETRIS AS A TEACHING TOOL

To quote Confucius, "I hear and I forget. I see and I remember. I do and I understand". Educators can be challenged in developing interesting and applicable assignments that reinforce the key concepts of the material being taught. Having had many years of project management experience as well as a love for the game of Tetris, one of the authors said on a number of occasions "everyone should be required to become an expert in Tetris if they want to be good at project management". This declaration was made due to the knowledge that to be good at the game of Tetris, one must make decisions quickly; adjust for decisions that may not have been optimum; and overall, keep the game moving. Why not use the game Tetris as a tool to improve these skills? After all, most students are at least somewhat familiar with Tetris. The hope is that by playing the game of Tetris, decision-making and project management skills could be better learned and reinforced.

Students are given the assignment of playing the game Tetris and are also provided a series of questions to help guide them in their assessment of the game. They use an online link: www.play-tetris-online.com/tetris5.html . The students are required to play the game a minimum of four times in order that they begin to feel comfortable with the objective of the game. Each student records his/her four scores (including score, level, and lines) and answers a series of questions (see Appendix). To ensure that they actually played the game, they take screen shots of their four completed games and submit those with their final assessment.

There are various similarities between Tetris and effective project management. The game of Tetris emphasizes the constraints of project management. For example, time constraints are often struggled with and not fully realized until they are forced to move forward due to the amount of time available. If students

are not quick to decide where the tetrominoes should be placed, they will ultimately fail the game. The expectations of students are not actualized until the constraints of project management are forced upon them. This can be a direct comparison to supply chain issues of just-in-time inventory.

Tetris is able to effectively enforce various constraints that the students do not realize until reviewing the process of the game and how their actions affected their performance. Often, students have 'ah-ha moments' or epiphanies when correlating their performance with the process of decision-making and project management. By having the students play Tetris with project management in mind, they are able to visually understand the effects of project management constraints and the true importance of decision-making. In addition, studies have shown that anxiety impacts decision-making abilities (Snyder et al., 2010). Most students are not aware of how stress can alter or cloud their thinking until they are in a situation where this is simulated for them.

TEACHING TOOL RESULTS

Open-ended assignments often produce unanticipated results especially the first time it is used as an assessment tool. Students may not initially take this assignment seriously since Tetris is a game. Yet after 'playing' the game a few times, and answering questions associated with project management and decision-making, students tend to see the direct correlation to what they are learning in class. Evidence that students take this seriously is manifest by their relative improvement of scores.

With good project management planning, it is known when resources are to be available, but there are times when even with the best of planning, resources are not able to start on a task when scheduled. This can impact the best of plans and create a need to adapt. The project manager then must shuffle staff around; redistribute, and rework schedules. In Tetris, the player must work with what is provided.

Most students begin their first game with a specific strategy on how to maximize their score. Their strategy changes as they must adapt to the resources provided and see firsthand that a project cannot simply manage itself. This strategy can be somewhat confusing at first with their decisions being clouded and their options being broad. But the students soon learn that they must abandon their original strategy of completing an entire row for the good of the game. This directly relates to projects and the need to continue moving forward even when challenges occur along the way.

Additionally, the students are also to determine the differences between the game Tetris and Project Management. This can vary based on the version of Tetris used. For example, some versions have a finite number of levels to be reached (e.g. 10). Other versions have a time limit. These may be more in-line with true project management, whereas the version used in the assignment discussed, has an unlimited number of levels, rows, and top score thus with regards to a project and a defined 'end', there really isn't an end. Students are asked to suggest ways to make it more like a project with an actual 'goal' that is well defined.

STUDENT RESULTS

The authors strongly believe that the use of this assignment as a teaching tool was a strong success. Students' attention is grabbed from the start when they are informed they will be playing a game as an assignment. Students comment about its use in making project management and decision-making studies make sense. Students are able to absorb and retain the information. In fact, many students have continued playing the game in subsequent semesters and 'report back' their scores to see if they have beat the course record.

With Tetris, the pieces are randomly provided to the player / student. The player must then decide where best to fit this piece in order to maximize elimination of rows and to keep the rows from building too high. (Hoogeboom and Kosters, 2004). Players generally start out trying to leave no gaps in the rows. After awhile, this perfection cannot be reached and thus they see they must find the next-best option. This struggle was exhibited by a student's statement, *"I started to pay so much attention to getting a certain shape that I did not even try to figure out the best move I could have achieved with what I was given."* This directly relates to project management for when a resource is not available or when a deadline has not been met. A project manager cannot simply freeze in their tracks and do nothing, rather must keep moving forward, knowing that the missing task will be completed later.

Besides becoming a better Tetris player, students learn about the impact of their choices. They learn about adaptability and the need to deal with resources with which they are dealt (Bdolah and Livnat 2000). This is illustrated by a student's comment of, *"I started thinking about what I could accomplish with the shapes that I was being given instead of what I needed."* They also learn about making decisions under stress and that mistakes can be fixed. And these directly impact their abilities to problem-solve (Carr, 2005). All of these aspects the students learn directly relate to goals of teaching project management and decision-making.

In practically all aspects of life, decision-making is impacted when one is under stress. As the game of Tetris progresses, the rate at which the pieces appear and 'drop' increases, as does the music, thus increasing heart rates (Héberta, 2005) and our need to make a decision faster. For example, when asked *"As the number of rows got higher, what did you now see happening?"* one student stated *"As the deadline approaches and work is not getting finished, I start to feel rushed. I try to avoid this because this is when an error is most likely to be made."* This statement conveys how the level of stress the student was feeling affected their overall performance and ability to make further decisions (Wittmann, 2007). With poor decisions, the blocks stack higher and before long, the game may be over. With projects, as a deadline gets closer and progress isn't being made as planned, poor decisions are made. How is this remedied? Becoming more comfortable and relaxed with the decisions made in turn helps improve the decisions that are made (Keinan, 1987). A student who had performed the assignment learned this valuable lesson and expressed the lesson learned by stating, *"It is key to keep your frustration and anxiety under control so you do not make wrong decisions because of it."* By providing an environment in which similar situations have been encountered in the past, one becomes more relaxed and thus able to make those decisions without the added anxiety. Tetris can be seen as 'practice' or 'training' for those high stress times (Hoogeboom and Kosters, 2004). The more prepared, then the more accurate the decisions will be. This is illustrated by one student's comment, *"Lessons-learned from project management are always useful for future projects because you learn from your mistakes and experience is one of the major factors that counts in decision making."*

Lastly, by definition, a project is a new endeavor. So, when challenges in which the best option wasn't pursued are considered mistakes or simply a learning process, one learns from those mistakes enabling them to be more powerful in their problem-solving abilities later on. As one student stated, *"In Tetris, you learn from each game you play."*

By having students perform this assignment multiple times, the authors found that the students generally improve their scores from game 1 through game 4, and they attribute this to their being more calm due to "practice" or "experience" in their abilities to make decisions under duress. The following table shows average level, lines, and score for all students completing the assignment in one term:

	Game 1	Game 2	Game 3	Game 4
Level	3.48	4.80	5.41	5.93
Lines	26.77	36.09	41.36	45.05
Score	5588	10231	9978	12130

Table 1. Average scores for each student, Fall 2010

Success at this point is also measured by the students' comments throughout their assignments. Some representative comments:

> *"This is a very fun, frustrating and addicting game. Its relation to project management is subtle and astonishing."*
>
> *"From playing Tetris today, I feel those that get the higher scores get them by effectively thinking ahead and strategizing."*
>
> *"I just want to comment and say that I was impressed by how a simple tool/game like tetris is able to be compared to project management to help portray the many variables incorporate into project management. Very cool idea."*

CONCLUSIONS AND FUTURE WORK

Project management and decision-making skills are necessary to be successful in almost all areas of business. Teaching these skills can have challenges when students are unable to grasp the application of the concepts. Introducing a tool that allows students to experience firsthand the similarities that they may encounter with decision-making helps students better understand key concepts. The tool utilized also allows students to question "what is a project?" since depending on the version of Tetris used, the game may not in itself be able to fit the definition of a project.

This paper details the use of the game Tetris in introducing key decision-making concepts. In addition, due to the popularity of the tool, students become quite engaged and appear to dedicate more time to the assignment, with some students continuing to play the game, thus improving their skills, well beyond the end of the term.

The authors believe this assignment is helpful in teaching decision-making, based on the comments of the students, their ability to compare and contrast the game with the application of decision-making and their realizations of how their decisions affected the outcome or overall performance within the game. When the students are able to walk away from the assignment discussing where they could have improved, this demonstrates that they have been able to grasp the concepts of decision-making and the strategy within project management.

Future work should cover experimentation with control groups to test effectiveness in learning and reinforcing project management and decision-making skills. Key attributes for project managers include the ability to make decisions fast, yet accurately. Different versions of the game Tetris might be studied to compare game-ending strategies such as highest level met; score achieved; or total time reached.

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APPENDIX

Questions the students answer:

1. Your name and section time
2. The best overall scores you received in the online game. MUST SHOW a minimum of 5: for each, show level, lines, and score
3. Answers to the following:
    a. Your strategy at the very beginning of the game
    b. As the number of rows got higher, what did you now see happening?
    c. What parts of the game affected your decision-making?
    d. What happened when you didn't get the 'right piece' in a timely manner?
    e. When you tried the game again, how did your strategy change?
    f. Game over, is it 'complete'? What determines the end of the game?
4. Comparison of Tetris to what you already know about Project Management (be sure to compare each item to your experience with playing Tetris):
    g. What is your initial strategy in terms of balancing the triple constraint, i.e. scope (goals and what is to be accomplished), time (or schedule to get things done), and resources (money, people, and being provided the resources WHEN you need them)?
    h. We have all worked with folks who are afraid of making the wrong decision, so they either drag out their decision or make NO decision. How does that compare here?
    i. As time goes by (and you get closer to your 'deadline') and parts of your 'project' are not getting completed as you would have liked, what do you now see happening?
    j. What may affect your decision-making (generally) in project management?
    k. How might you adjust the project if you don't have resources when you need them?
    l. Tetris does have one major difference from project management: by definition, a project is unique; has an achievable goal; and it has an end. How might we 'redefine' the game Tetris (or more specifically, the 'game over') so that it IS more inline with the attributes of a project?
    m. How might you incorporate lessons-learned from project management into future projects?
5. Any additional observations?