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Procedia - Social and Behavioral Sciences 182 (2015) 197 – 202

Procedia Social and Behavioral Sciences

4th WORLD CONFERENCE ON EDUCATIONAL TECHNOLOGY RESEARCHES, WCETR-2014

Tracking the behavior of players in a finance simulation and identifying work patterns

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Abstract

This paper summarizes the results of using an Excel-based simulation run on a finance course. The activity intends to instruct the students that firms with a negative cash cycle and with negative working capital needs do not have to borrow short term bank debt because growth in sales provide funds spontaneously. Students' learning has been assessed using achievement tests and analyzing traces. Conclusions of the research are: students stayed active, focused their work on the key actions, and worked where the instructor wanted them to work; there was knowledge acquisition since the tests provide evidence of learning; and the activity was well-accepted by the students.

Peer-review under responsibility of Academic World Research and Education Center.

Keywords: Simulations; working capital; Excel; achievement tests; traces; R statistical environment; feedback survey

1. Introduction

Some concepts, phenomena, and dynamics are complex and difficult to understand using traditional methods, such as lecturing. Today's professors have to face with a lack of motivation and engagement by the students, and have to think of activities to make students stay active. In contrast, current state of technology allows the existence of a wide range of interactive tools to bring to class. Simulations are used to emphasize the concepts taught in class

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Peer-review under responsibility of Academic World Research and Education Center.
doi:10.1016/j.sbspro.2015.04.756

using traditional methods. This paper summarizes the results of using an Excel-based simulation run on a finance course.

The research consists of using three methods to verify: whether the activity incentivizes the students' work (active learning); whether there is a generalized work pattern among students (focused learning); whether the activity increases students' comprehension of the key concepts previously specified (increased knowledge); and whether students' attitude is receptive to these innovative teaching methods (students' attitude). Everything is done with the aim of improving the learning of future cohorts of students.

We should distinguish between game, simulation, and simulation game (Ellington, 1981). Games consist of any activity in which the user competes with others to achieve a goal. Simulations are virtual representations of reality. The player can experiment but is not able to alter reality. The results of the simulation are always the same, and the player can only visualize some fictitious situations. Simulation games refer to a combination of both. They consist of activities that are live representations of reality in which players compete. The activity referred to in this paper falls within the category of simulations, because it is a virtual representation of reality and does not involve interaction among the players.

Listing the benefits of simulations, Ezz, Loureiro-Koechlin, and Stergioulas (2012) remind that there is a need for non-conventional tools in education. They are more effective than lecturing with regards to theoretical concepts, which are difficult to assimilate and retain after some time. Visual examples are easier to understand and assimilate. Simulations allow students to practice *in vivo* the theoretical concepts taught in lectures. Simulations capture the attention of users, make them stay active, and accelerate learning. Learning is based on trial-and-error. Students are able to observe the consequences of their decisions. Simulations promote decision making and allow evaluation of human reaction to given situations. They allow failing without cost and can be stopped at any moment to analyze the effects of any previous decision. They also allow users to face situations rarely encountered in reality and for which they should be prepared. Finally, the authors state that simulations are an appropriate methodology, because today's students are "digital" and therefore completely familiar with these tools.

Randel, Morris, Wetzel, and Whitehill (1992), Terrell and Rendulic (1996), Prensky (2003), and Tao, Cheng, and Sun (2009) remark that simulation games cause an increase in user's motivation to learn.

Salas, Wildman, and Piccolo (2009) argue that the value of a simulation depends on the acceptance of the tool by the students, on quantified results (to what extent they have learnt in line with the expectations of the teacher), and on the students' behavior *a posteriori* (to what extent their knowledge increases). In sum, it depends on whether the user is ready to experience the simulated situation.

2. Activity description

The activity was conducted in the 2013-2014 academic year of the IQS School of Management Degree in Business Administration and Management as part of "Management Control", a third-year course. There were three groups, with 51, 63, and 39 students respectively. 114 students participated in the entire activity (pre-test, simulation, post-test), representing 75% of the total number of students.

The activity intends to instruct the students that firms with a negative cash cycle and with negative working capital needs do not have to borrow short term bank debt because growth in sales provide funds spontaneously. Students are given sales and other financial data from an automotive company for a five-year period. Then, they have to forecast the net cash flows and have to conclude that the firm can fund its growth in sales relying on growing negative working capital needs, even generating an excess cash.

The two knowledge components to be taught are: 1) "receivables, inventories, payables, and working capital needs are proportional to sales, provided that days of collection, inventory, and payment do not vary" and 2) "when working capital needs are negative and decrease with sales, growth in sales provide funds spontaneously and there is no need to borrow short term bank debt."

Conventional wisdom says that firms have positive cash cycles, a positive working capital, and positive working capital needs. However, retailers collect immediately, have low inventories, and pay late, with negative cash cycles, a negative working capital, and negative working capital needs, and are profitable, solvent, and liquid. Retailers' working capital needs are negative and growing with sales, and sales generate funding from suppliers, which is for free. This phenomenon also occurs in the automotive industry, in which sales are collected in less than one month,

inventories are low because they use the just-in-time manufacturing philosophy, and payments to suppliers are delayed.

SEAT simulation is based on a growth plan designed by the Spanish firm before the economic recession in which a doubling in manufacturing capacity and sales was forecasted. The Excel-based simulation shows actual data for 2007 and forecasted sales, net income, and fixed assets for the period 2008-2012. Students have to fill the cells and notice that: working capital is negative and growing with sales; the cash generated along the period from the operations and the working capital exceeds the cash outflows due to the investments in fixed assets; and a huge cumulative free cash flow is generated along the period. Students have to complete the growth plan by filling 12 cells per year (60 cells in total), following a logical sequence. The main outcomes of the simulation are the free cash flow, on one hand, and the funding operations, on the other hand.

3. Methodology

In order to comply with methodological triangulation, three sources of evidence have been used in this research. The three methods used to assess the students' learning are: achievement tests (pre-test and post-test), the collection and analysis of the students' trace files, and a feedback survey. Traces are analyzed using the R statistical environment to identify work patterns.

The purpose of achievement tests is to measure the influence of student participation on learning outcomes. By measuring knowledge and attitudes before and after the activity, the effectiveness of the activity can be measured. The pre-test is passed before running the simulation and the post-test after running it. Both tests consist of the same questions.

Analysis of traces allows us to track all the students' actions when filling in the Excel cells. Among the students' actions tracked are CELL_CHANGED (a value or a formula is entered in a cell or a range of cells) and SHEET_CALCULATE (a cell with a referenced formula is re-calculated). The most informative type of action is CELL_CHANGED, which allows us to check whether the value entered by the student is correct.

The feedback survey consists of a set of questions to be answered according to a scale ranging from total disagreement to total agreement. The survey consists of twenty-two questions. Three of the questions are open. Some questions refer to the students' perception of the usefulness of the simulation ("The activity accelerates learning"). Other questions measure the degree of satisfaction ("If I was offered to do it again, even if it were not compulsory, I would do it again").

4. Results

The two knowledge components to be taught are: 1) "receivables, inventories, payables, and working capital needs are proportional to sales, provided that days of collection, inventory, and payment do not vary" and 2) "when working capital needs are negative and decrease with sales, growth in sales provide funds spontaneously and there is no need to borrow short term bank debt." The pre-test and post-test consisted of a set of questions related to these two knowledge components. Answers were corrected in a binary way (right/wrong). As far as the first knowledge component is concerned, percentage of correct answers to the pre-test was 59% (for the three groups combined), while percentage of correct answers to the post-test was 76%, showing an improvement of 17 percentage points. In regards to the second knowledge component, percentage of correct answers to the pre-test was 10%, while percentage of correct answers to the post-test was 18%, showing an improvement of 8 percentage points. The Wilcoxon test was used to assess that the results are significant and not due to hazard.

Reliability of a measurement tool refers to its capacity to deliver always the same results, provided that conditions are always the same. In order to verify the significance of the results, the Spearman-Brown formula was used to assess the reliability of both pre-test and post-test. Reliabilities of the pre-test and post-test are 0.83 (medium) and 0.75 (low-medium). Hence, results can be considered significant.

Students performed 25,778 actions in total. CELL_CHANGED actions were 11,516 (45%) and SHEET_CALCULATE actions were 9,584 (37%). Almost all the students remained focused on the activity and did not leave the EXCEL spreadsheet (65 out of 119 students did not minimize the Excel spreadsheet, and 81 out of 199

students did minimize the Excel spreadsheet less than 5 times). Figure 1 shows the number of CELL_CHANGED actions per student, and allows us to conclude that 83 out of 119 students (70%) needed from 60 to 120 CELL_CHANGED actions to complete the activity.

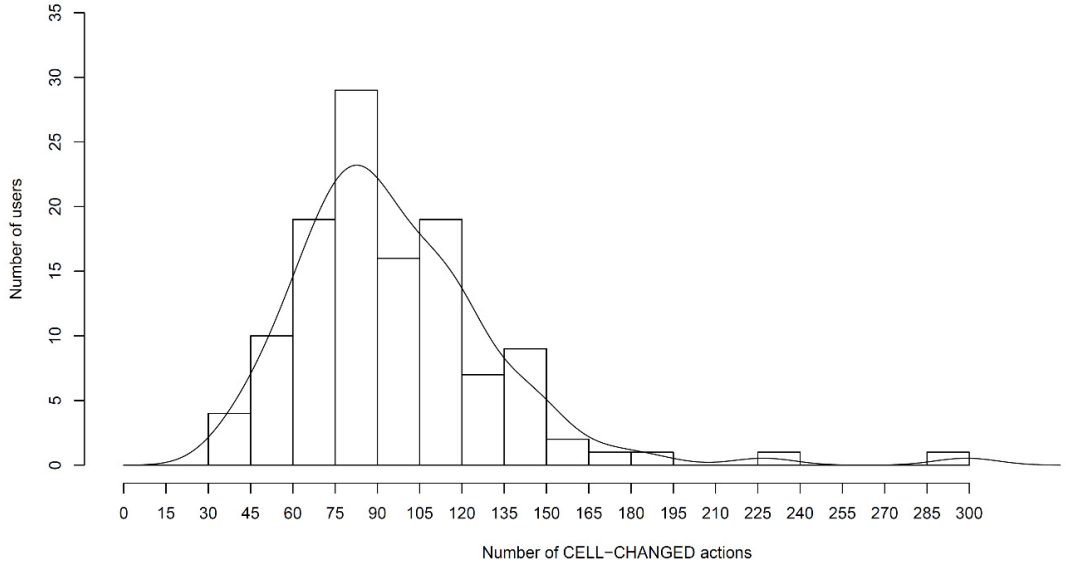

Figure 1. Number of CELL_CHANGED actions per student.

Figure 2 shows the students' actions and the minute of the action. Each point in the graph is an action. Each column is the set of actions of a given student. The X-axis represents the 119 students and the Y-axis represents the minute each action is carried out. Two results are obtained from the analysis of the graph: students carried out the last action after 60-80 minutes; and students who spent more than 60 minutes remained inactive (did not carry out any action) for 10-20 minutes before carrying out the last action, maybe because they reviewed the results. Despite the second result, students stayed active and the simulation did not induce inactivity.

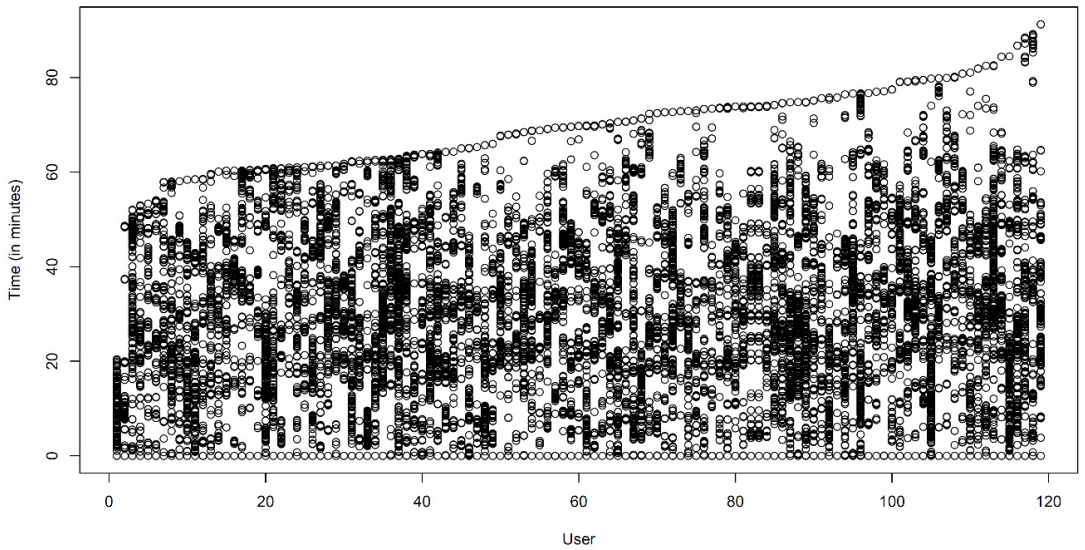

Figure 2. Students' actions and minute of the action.

In order to assess whether the students completed the task correctly, 10 actions were identified as key actions. Correctly filling in the 10 cells corresponding to the 10 key actions indicates that the student has succeed in the task completion. The 10 key actions and the corresponding 10 cells are listed in table 1, and the number of students who correctly filled in the 10 cells is presented. Few students correctly filled in the cells for actions 3, 4, and 5. They had to forecast receivables, inventories, and payables for 2008, taking into consideration the actual amounts for 2007 and the sales forecast for 2008. After some time, values for these cells were given by the instructor in order to allow the students to continue the activity. That is why the number of students who correctly filled in the cell for action 6 is 118 (one of the students left the activity temporarily at this point; the value for cell C16 was also given by the instructor and the student continued the activity).

Table 1. 10 key actions, 10 cells, and number of students who correctly filled in each of the 10 cells.

Action	Cell	Students
Action 1	C5	119
Action 2	C6	111
Action 3	C42	28
Action 4	C43	36
Action 5	C44	34
Action 6	C9	118
Action 7	C10	118
Action 8	C11	112
Action 9	C16	119
Action 10	G26	86

However, each of the 10 cells were changed more than 1 time per student. For instance, the cell associated to action 3 was changed 473 times, almost 4 times per student on average. By contrast, the cell associated to action 1 was changed 140 times, more than 1 time per student on average. More than 1 change per student per cell indicates that the student has difficulties to complete the task.

On the other hand, actions 3, 4, and 5 were carried out by few students and were carried out within the time interval from minute 20 and minute 40.

The feedback survey shows that for most of the questions, "agreement" in regards to the usefulness of the simulation (including all degrees of agreement) is higher than 75%. As far as the open questions are concerned, students do value the dynamism of the activity and the ability to practice and consolidate concepts taught in lectures.

5. Discussion

Analysis of traces demonstrates that only one third of the students could have completed the simulation autonomously, without the assistance of the instructor. Actions 3, 4, and 5 were challenging for them.

The second knowledge component is also challenging for students, compared to the first. Percentages of correct answers were lower in both tests for the second knowledge component (10% and 18%, compared to 59% and 76%). However, the learning improvement was larger in the second knowledge component (8 percent points, 80%, in the second, compared to 17 percent points, 29%, in the first and). The results show that at the end of the activity 76% of students knew that "receivables, inventories, payables, and working capital needs are proportional to sales, provided that days of collection, inventory, and payment do not vary," but only 18% of students knew that "when working capital needs are negative and decrease with sales, growth in sales provide funds spontaneously and there is no need to borrow short term bank debt."

The results presented in this study support the Ezz, Loureiro-Koechlin, and Stergioulas (2012) assertion that simulations are effective, capture the attention of users, make them stay active, and are a widely accepted methodology. We cannot say if they are more effective than lecturing as a means of teaching theoretical concepts because the activity was not designed with an experimental group (which runs the simulation) and a control group (which is exposed to additional lecturing instead of running the simulation).

On the other hand, the simulation is valuable and effective because it was well accepted by the students and they learnt what the professor expected them to learn, thus supporting the argument made by Salas, Wildman, and Piccolo (2009).

6. Conclusions

The main conclusions of the research are: students stayed active and the simulation did not induce inactivity; students focused their work in the key actions and worked where the instructor wanted them to work; there was knowledge acquisition since the tests provide evidence of learning and the results are not due to hazard; and the activity was well-accepted by the students.

Acknowledgments

The research leading to these results has been carried out using funds from the agreement between the Universitat Ramon Llull (URL) and the Departament d'Economia i Coneixement of the Generalitat de Catalunya. The authors wish to express their gratitude to X. Jolonch and N. Avery for their revision of a previous version of this manuscript.

References

Ellington, H. (1994). Twenty years of simulation/gaming: Reminiscences and thoughts of a Scottish practitioner. *Simulation & Gaming, 25*(2), 197-206.

Ezz, I., Loureiro-Koechlin, C., and Stergioulas, L. (2012, December). An investigation of the use of simulation tools in management education. In *Simulation Conference (WSC), Proceedings of the 2012 Winter* (pp. 1-14). IEEE.

Prensky, M. (2003). Digital game-based learning. *Computers in Entertainment (CIE), 1*(1), 21-21.

Randel, J. M., Morris, B. A., Wetzel, C. D., and Whitehill, B. V. (1992). The effectiveness of games for educational purposes: A review of recent research. *Simulation & Gaming, 23*(3), 261-276.

Salas, E., Wildman, J. L., and Piccolo, R. F. (2009). Using simulation-based training to enhance management education. *Academy of Management Learning & Education, 8*(4), 559-573.

Tao, Y. H., Cheng, C. J., and Sun, S. Y. (2009). What influences college students to continue using business simulation games? The Taiwan experience. *Computers & Education, 53*(3), 929-939.

Terrell, S., and Rendulic, P. (1996). Using computer-managed instructional software to increase motivation and achievement in elementary school children. *Journal of Research on Computing in Education, 28*(3), 403-414.