Brazilian Students and Working Capital: An Analysis of Their Decisions When Using Virtual Market Business Games*

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This study aims to demonstrate that data from business games can be an important resource for improving efficiency and effectiveness of learning. The proposal presented here was developed from preliminary studies of data from Virtual Market games that pointed the possibility of identifying gaps in learning by analyzing the decisions of students. This proposal helps students to refine their learning processes and equips tutors with strategies for teaching and student assessment. The proposal also complements the group discussion and/or debriefing, which are widely used to enhance learning mediated by games. However, from a management perspective the model has the potential to be erroneous and miss opportunities, which cannot be detected because of the dependence on the characteristics of the individual, such as ability to communicate and work together. To illustrate the proposed technique, data sets from two business games were analyzed with the focus on managing working capital and it was found that students had difficulties managing this task. Similar trends were observed in all categories of students in the study—undergraduate, postgraduate and specialization. This discovery led us to the analysis of data for decisions made in the performance of the games, and it was determined that indicators could be developed that were capable of indentifying inconsistencies in the decisions. It was decided to apply some basic concepts of the finance management, such as management of the operational and non-operational expenditures, as well as production management concepts, such as the use of the production capacity. By analyzing the data from the Virtual Market games using the indicator concept, it was possible to detect the lack of domain knowledge of the students. Therefore, these indicators can be used to analyze the decisions of the players and guide them during the game, increasing their effectiveness and efficiency. As these indicators were developed from specific content, they can also be used to develop teaching materials to support learning. Viewed in this light, the proposal adds new possibilities for using business games in learning. In addition to the intrinsic learning that is achieved through playing the games, they also assist in driving the learning process. This study considers the applications and the methodology used.

Keywords: business game; teaching-learning process; teaching-learning in the engineering courses

1. Introduction

Despite the fact that business games have been around for more than 50 years [1–2], they have yet to be embraced in Brazil [3]. Research shows that in Brazilian Business Administration Schools only 38.2% of the courses use games [4], while in American Business Schools of Administration the scarcity and the cost of the business games have contributed to limit the use of them [1]. This situation has stimulated the development of business games to support the teaching of business management in undergraduate courses in engineering at UNESP (Univ. Estadual Paulista), campus of Bauru. The research presented in this paper is an offshoot of using this system, and is conducted on the Internet and monitored externally.

'The game Virtual Market aims to facilitate the learning of content related to areas of production engineering, engineering, finance, economics, accounting and business administration and be a tool for research in these areas' [5, p. 1]. To achieve these goals, the game was developed to perform the following functions:

(a) To be a communications interface with the user during the execution of the game;
(b) Process players' decisions and develop reports that track the decisions and provide a ranking on performance;

(c) Allow everyone to compete directly with each other;

(d) Act as a medium that encourages the learning of subjects such as business administration, economics, engineering economics and planning, and production/process control, among others;

(e) Simulate the behavior of specific markets;

(f) Accessible over the Internet with the minimum possible demand of resources used by the user, and

(g) Provide information and data for research on the development and use of business games.

Game and simulators are multidisciplinary systems that provide a suitable environment for engineering education [6]. They can be used to help students to connect contents that it was learned in different disciplines or as a multidisciplinary environment where students can learn and develop abilities and competences in managerial area [7]. In case of engineering area, it must considered that:

> (…) an effective engineer must possess a broad range of knowledge and skills, extending far beyond the technical expertise of his or her discipline. An engineer must command not only an understanding of theory, but also the skills necessary for the successful elevation of theory to practice: powers of critical analysis, effective communication skills, the ability to perform well in a team, managerial skills, and a capacity for lifelong learning [8, p. 633].

So, this research presents the feasibility of using data from the decisions of players to improve the performance of business games and simulators, making them more efficient and effective in supporting the teaching-learning process. The proposed technique could be adapted to other cases, but the games and simulators developed for the Web have the greatest potential to benefit from it because the strategy aims to make learning as autonomous and efficient as possible through a process of interaction with the user. The research was performed using the decisions stored in a database of the Virtual Market business game. As the game was used by a large number of undergraduates, postgraduates and Master Business Administration (MBA) students, certain undesirable patterns of behavior began to be observed.

With the objective acting preemptively to these traits, a comprehensive analysis of data was undertaken involving the use of financial resources, production capacity and credit (either in the granting of credit—sales credit, and in the use of credit—term purchases, loans, application and amortization). Some mistakes were observed in the management of financial resources of enterprises by some players who neglected to place available cash in financial investments, did not amortized loans when there was cash flow and sometimes tried to simultaneously manage loans, financial investments and cash flow. The last case is the most critical, since the interest rates for the loans were higher than those for financial investments (a condition of the simulation model) and excessive spending on interest as players attempted to cover interest expense instead of using cash flow to repay the loans. Table 1 illustrates the behavior of a team in a match played in 2008.

The first column is the team and the second is the move (game in the match), the third is the contribution from financial investments, the fourth is the active loans, the fifth is the emergency credit (provided automatically by the system to cover lack of cash) and the sixth is the cash balance at the end of the move. This data is interpreted as follows: although the team has received an emergency loan in the first move, in the second move, they should have used the available cash to repay the loan instead of making an investment. They continued to repeat this mistake in next two moves, as evidenced by the increase in investment income from $500.00 to $5,000.00 and then to $30,000.00. Interestingly, during this same period there is an increase in the balance of cash from $2,228,326.85 to $6,430,612.79 and $4,440,723.61. Despite financial information including income and interest expenses being reported in the Income Statement, it is obvious that the manager of the team did not read the report or did not understand it as the situation continues unabated.

The question that arose after observing this behavior was 'how to avoid it' or 'how to marginalize it' because it is a strong indication that knowledge related to financial management is lacking. From the perspective of the management of undergraduate courses, this data suggests the need to examine why managers and engineers are displaying this

Table 1. Example of application of surplus funds

Team	Move	RNOPER	DNOP	LOAN	EMERG. CREDIT	CASH
392	1	0.00	400,265.35	0.00	13,322,278.40	100.00
392	2	500.00	199,834.18	13,322,278.40	0.00	2,228,326.85
392	3	5000.00	199,834.18	13,322,278.40	0.00	6,430,612.79
392	4	30000.00	199,834.18	13,322,278.40	0.00	4,440,723.61
392	5	30000.00	214,296.91	13,322,278.40	482,191.01	100.00

RNOPER non-operating income for the move. DNOP = non-operating expense for the move. EMERG. CREDIT = Emergency credit.

behavior, while from the perspective of the development of the simulator, the issue to be addressed is what can be done within the system itself to minimize this behavior given the limited amount of exposure of players to the Virtual Market game.

The goal is to enable experience of the management process without the traditional in-person interaction that has overwhelmingly characterized the use of game simulators. In this sense, experience does not necessarily include the in-person discussion of data and results from teams. The simulator is flexible enough to adapt to teaching/learning strategies of distance learning as well as in-class learning.

The proposal to use the players' decisions to make learning more efficient and effective together with the support of indicators specifically designed for this purpose allows decisions to play an extra role in most of the games and simulations: guiding and directing the learning of the user.

For this study, game simulators and have sufficient similarities to be treated equally, because the attention given to the decisions of the players. Another limitation that is imposed on the study is the way in which the game is released— only remote access is available and in-person meetings to discuss the results are not obligatory.

These restrictions are intended to emphasize the contribution of the proposal, because in the executions of teaching and learning process it is necessary to adopt complementary technologies to reproduce part of the teaching and learning activities offered through in-person interaction in the classroom. The forums, chats, blogs, online services, tutorials, discussion boards, FAQs, videoconferencing facilitates distance learning, while the game or simulator, facilitate learning through interacting with 'an object'.

In this way, this proposal presents itself as relevant and timely by creating possibilities for leveraging learning games and learning simulators.

2. Literature Review

The creation of the business games in the form of board games and war games dates back to ancient China, around 3000 BC [7] and have been used as a teaching resource for over 50 years [1, 9, 10, 11]. These games have the ability to 'provide experiential learning' (40.9%), 'to provide an integrated functional areas' (31.9%), 'to provide theoretical approach' (28.6%) and 'to provide experience of decision-making process' (22%) [11].

The increased availability of these simulation systems has not been sufficient to expand the use of business games and it still remains a challenge to incorporate them into curricula and teaching practices. A survey with business schools in the United States of America listed reasons why it is more difficult to incorporate this methodology of teaching and learning for those who have yet had exposure to the technique; (a) inefficient communication by the developers of these systems (an important reason for non-users not to adopt the system), (b) the time required to prepare and (c) weak relationship with the disciplines. The survey also showed that 29% of the group cited lacked of information as a factor that hinders the adoption of business games in the curriculum for a discipline [1, 10].

The forerunners to modern business games date back to 1932 in Europe and 1995 in North America [12]. Nevertheless, they are still underused in Brazil [3, 13] and [14]. Business games in Brazil was first used in 1962, however, there is some controversy on where this occurred. There is a group of Universities mentioned as the first users, which are USP, UFRGS UFRJ and PUC [15], but at the same time Fundação Getúlio Vargas, in São Paulo City, is pointed out as the pioneer in the use of business games in business schools in Brazil [16]. One of the first publications on the subject of business game simulation in 1973 [17] and the first dissertation on the subject was written in 1977 [13].

Research into higher education institutions in offering business management conducted in Brazil in 2005 showed that 50% of respondents were using simulators in undergraduate studies, 60% in MBA curriculums and only 22.3% in doctorate programs. Based on the method of Bayesian credible interval, considering a uniform data distribution with a confidence level of 90% inferred that between 25.6% and 52% of institutions of higher education in business administration use simulators. These results contrast sharply with 78.9% for PhD/DBA programs, 11.4% for MBA and 9.7% for 'other' obtained from the research business schools in USA [1, 11].

A search of the largest database of researchers in Brazil, Platform Lattes [18], with the search criteria 'PhD researchers', 'business games', 'resumes updated in the last 18 months' and references to search 'papers' 'books and published chapters', 'work in events', 'text in the newspaper or magazine', 'other bibliographical publications' and 'guidelines completed' returned a total of 1021 researchers from a universe of more than 132,000 [18]. Note that this may include researchers from abroad.

The results were sorted and ranked in accordance with the density of academic output (the importance of scientific production and volume on the subject) and the result demonstrated that of the first 10 researches to appear in the list, five obtained their doctorates at the Federal University Santa Catarina, showing that, somehow, this university has had significant contribution to research, dissemination and use of business games in Brazil.

This data may explain, at least in part, the results obtained from three researches with users of business game. The first, it was held in 1995 at the São Paulo University [19], the second in 2002 at the Santa Catarina Federal University [20] and, the third, in 2009 at the São Paulo State University [21]. A small percentage of their research participants had previously used business games: 11.5%, 38.6% and 21.5% respectively. Fourteen years have transpired between the oldest and most recent research. The research was conducted in São Paulo at sites 250 km distant from each other. The data from the research indicates the importance and relevance of research on business games in Brazil and that there may be an expansion of their use. Furthermore, there appears to be additional factors that affect the use of games in higher education in Brazil.

This conclusion seems relevant considering that it has been ten years since the commencement of the annual national competition of business games for higher education students sponsored by SEBRAE—Brazilian Service of Support to Micro and Small Enterprises. However, the games are still little known and used, otherwise it would be reasonable to expect a larger percentage of users who already knew business games among the participants of research. Research with non-users of business games on the reasons for not using games found that the lack of disclosure by the developers is one of them [1, 11].

This findings support the theory that research involving the use of games and efforts to disseminate the results as well as those related to development and improvement of the games can help increase the use and acceptance of such systems.

With the objective of assessing how the business game 'Virtual Market' is contributing to the teaching/learning process in business management, specifically the content of the business administration subject for courses in engineering, we analyzed the decisions of the players. The analysis showed that these decisions might reveal some degree of difficulty with issues associated with games.

This discovery led to the proposal of using indicators as a strategy to improve efficiency and effectiveness of games in reaching the goals set for them in teaching and learning. By indicator means a standard reference obtained from data of the general population, such as average and standard deviation, a general concept such as profitability, the use of productive capacity and indications of specific areas such as current ratio and dry.

The preliminary proposal was limited to an indicator with a simple alert. Thereby, providing the user with a process of trial and error to help them understand when there is any non-compliance with their action and that something must be done to correct it. The second step was to create content for learning with the priority being content related to area in which there were the highest number issues.

Such research has demonstrated interesting results and serves to improve the games and their use. One of them was made with undergraduate students, grouped according to academic performance. The results indicate that the teams formed by students with the best average academic performance do not always get the best results for competitions using business games [22].

One possible explanation is that the skills and competencies valued and recognized in traditional systems of education are not the most important to achieve good performance in these games. Other possible explanations would be that students with better academic scores: (a) have difficulties collaborating with peers, (b) have difficulty when it comes to negotiating, for example, when defining the best strategy to be adopted by team in the competition they spend too much time discussing what to do and little planning of what to do and how it is done, (c) may have difficulty in leading and being led [22].

Despite criticism to be moderate or unusual to use of games as teaching-learning resource, sometimes it is pointed out that there is a false analogy between real business and simulated [23]. The critics consider that the business world is not risk free and there are serious consequences for errors in it. As business games are systems risk free, they may be promoting wrong thinking and behavior because their users tend to think there are not consequences to their fail. This situation is considered positive by advocates of business games, because they believe that players are able to learn without suffering full consequences of a real system. The logic being, that one can understand a certain course of action can lead to bad consequences without the need for this to actually occur.

When thinking about learning holistically, not as just a specific skill or technique, it can always be considered as something personal, non-transferable. If the learning obtained from practice (experience) is removed, there remains only the indirect learning process (reflection). At this point it seems that despite the games not being able to reproduce the full effect generated by any real situation, they are an alternative to experiential learning and, as such, can be used to great advantage in situations where there are risks and high costs [24–27]. It is therefore worth asking if the games could be designed to support for the teaching/learning process, rather than being mere means of interaction that provides learning.

This question provides a segue for the use of games in learning, and has guided research into

the possibility of empowering games with a means of interaction with the user during their use and could also be used for group experience, which is limited or mediated in a way where there is asymmetry between the participants as in the case of distance learning courses.

Although the developers of these systems strive to moralize the general conditions of use, differences from the users tend to require the customer to modify them. Not all have the same physical conditions (the differences between equipment, speed of network access, software support) the same content demands (own subject), the skills and competencies necessary to use the system, whether in its operation (domain of computer systems, language, codes), in the exploration and use of content (learning styles, competences and basic skills).

The advantage of this proposition is that part of the time use to normalize the conditions of the domain content can be used to analyze and discuss the successes and failures in the base assumptions and decisions (objectives set for the decision), namely to improve learning of the group as a whole, because it brings into focus the strategic aspects of decisions and the results generated by them. This is one of the key points of the game, because in many cases there will always be first and last placed, regardless of skills and abilities that players have.

As in real markets, not always the winning strategy is one that is guided by a theoretical framework, but rather is often one that has innovated in its context, i.e. one that has created differentiation in its environment [28].

2.1 Working capital in the game 'virtual market'

Working capital is defined the difference between the current assets and current liabilities [29, 30]. 'This traditional definition of working capital shows how much cash (or liquid assets) is available to satisfy the short-term cash requirements imposed by current liabilities' [29, p. 13]. In the game Virtual Market the current assets are composed of Cash, Investment, Inventory and Account Receivable and Liabilities are composed by current wages, accounts, taxes, interest and notes payables, loan and emergency credit. Materials and supplies can be purchased in cash or in nine installments without interest, while sales may be made with or without an installment option. When using sales with installments, the manager should set the percentage rate (0–100%) and number of installments in which the sale will be paid.

The management of working capital aims to optimize the use of capital by reducing the lack of capital and lack of opportunity. This first case would force the manager to borrow a more expensive line of credit (emergency credit) or not honor financial commitments. The second case would cause the company to miss opportunities to improve the efficiency of available resources. The financial reserves are scaled based on future information, i.e., hypothetical. Thus, there is the risk of error and therefore risk of the company incurring the cost of capital or lost opportunity. The management of company's financial decisions involve a range of duties, related to forecasting sales, production capacity, to the financing the purchase of goods and services as well as initializing consumer credit and require skills and expertise. The range of skills requiring technical competency include sales forecast, calculation of production capacity and cash flow forecasting, while in the competency decision making and risks taking is also required.

2.2 Model of teaching-learning process associated to the game

Games and simulators are implemented based on a model composed of three basic steps: (a) briefing, which is to present the game and its features [30–31], sometimes involving one or two moves to eliminate errors due the use of the system, (b) execution of moves to assert and (c) Debriefing [30–32], i.e., report of experiences and analysis and discussion of results. The model is adopted for both learning new content and for performing synthesis of previously learned tasks.

The use of games and simulators interferes with the teaching-learning process, which is understood as a set of activities that create conditions for learning and those representing the effort of learning. A system providing conditions for active learning and learning through experience [33–35] does not fit the model of teaching and learning that focus on the professor [36–37]. The initiative to learn should be the modus operandi the student, while guidance and correction of the learning path is the responsibility of the teacher. The teacher is responsible for evaluating and diagnosing potential misalignment in the goals of teaching and learning, while the student maintains alignment with his/her goals and learning goals.

Within this new framework of the teaching-learning process the student should have a positive attitude and conscientious disposition to learn, which contrasts with the traditional model that assumes that if the student seeks a school is because they want to learn. Very quickly, the school is obligated to teach based on a unidirectional action, from school to student, and schools success is measured by the students' ability to reproduce what was taught. The student is the central element from the perspective of active learning and learning from experience provided by games and simulators, through which teaching and learning is achieved.

The games and simulator are not knowledge per se, in the same way that teachers do not represent knowledge. What is important is not how much teacher and student know, but how much can be modified in the process, being of special interest to the student. The motivation [30] and opportunities to build knowledge are within the student; the other elements just act as support to the process of learning.

The use of games or simulators to mediate the teaching-learning process represents an improvement on the instructional paradigm which '... views the instructor as deliverers of content knowledge and students as passive recipients of knowledge' [38, p. 15]. As subjects in the teaching-learning process, student and teacher (tutor) have their own responsibilities. The task for the former is to keep him/herself focused on learning, and later, to provide resources and a favorable learning environment, as well as to create processes for evaluations.

The results of the plays form a comprehensive assessment and immediate action taken by the student (decision taken). However, there are several elements that contribute to a better or poorer performance during a simulation or game, and understanding of them one indicators related content area. The use of games and simulators indicators and systematic data analysis of decisions represents contributes further to the evaluation process. The indicators can be incorporated into computer routines for games and simulators to alert students to possible inconsistencies in their decisions and, together with the analysis of decisions, reports can be sent to tutors, to identify the main difficulties of each student and develop appropriate remedial strategies.

3. Method

The research method adopted in this research is exploratory and was conducted with data obtained with the business game Virtual Market using students of the master's program in industrial engineering at UNESP, Bauru, in 2009 and with the students of the specialization course in Production Engineering, at UNESP Sorocaba. These two groups had only a spreadsheet to support the simulations of the plays, to check if it was possible to produce the required quantities, to provide revenue and profits reports. Data from these two groups was analyzed with the aim of identifying possible uses of indicators to assist in the teaching-learning of 'productive capacity' and 'cash flow'. The research will be limited to these two parameters with respect to the indicators, because the goal is to show that these could be used and to help improve the use of business games and simulators. The second is used

to compare the decisions of the two groups regarding the cost of capital and opportunity. To this end, the decision to ask for a loan and the associated emergency credit was compared. The two groups were also analyze in relation to 'the occurrence of emergency credit', since this is an indication of failure to predict the need for capital.

The following data processing schema for the Virtual Market system was also developed: (a) the system allows students to make decisions on production beyond the capacity of the company, correcting the quantity when data are processed. This feature is intended to help the student to learn the content and practice the calculations related to productive capacity, (b) the game does not allow a company structured and functioning for the student to take over its control from a given state. To the contrary, the student has only the initial capital of the company and a pre-approved credit of around 40% of this value, (c) Plays can be performed with the expertise not limited by the amount of equipment purchased by businesses. It was assumed that the students with basic knowledge would be able to assess the risks associated with the creation of companies with excessive investment, (d) In the game performed by the masters students this variable was controlled. Even though there were no cases in which a mega-company would have been created, it was decided to impose this type of control because some companies started to develop data not sustainable in a competitive market due to the accumulation of successive major losses and high debt, especially by managers who did not matter the concepts related to price and cost; (e) The system also calculates the current liquidity, but this calculation had to undergo an adaptation. As the game follows a model, unusual situations could occur, such as companies that could not use third-party capital. In these cases it would be possible for the liquidity ratios to become infinite due to the division by zero. From the pedagogical point of view, it would be meaningless. So, the liquidity ratios were transformed into a scale for the system, which is highly adaptable to various situations in the game.

There exist a situation where it is possible to permit decisions that would cause production to be in excess of the capacity of the company, but this error is corrected linearly by decreasing values until the total processing time equals the time provided by the production system, i.e., until the capacity demanded equals the installed production capacity. Both values are stored in the database allowing you to identify this type of inconsistency by comparing them. As the adjustment is linear, the comparison was made only for the product 1.

Assessments of appropriate use of cash, investments, and the amortization of the loans were made

considering the base model construction from the income statement, in which, revenues and interest expenses (revenues and non-operating expenses) were added between the net profit before income tax and operating profit [39]. This means that financial management is sufficient to produce the maximum possible positive result from the subtraction of non-operating income and expenses (when the company's investments exceeds its commitments) or the least possible negative outcome from the same operation (when the company is dependent on third-party capital and does not have enough resources to cover non-operating costs, but can reduce them with appropriate financial management). This is achieved by minimizing costs and maximizing the revenues.

In this case, the indicator assesses whether there is cash exceeding $1,000,000.00 without investments. If so, a message is sent to the report box. It also evaluates whether there is available cash and borrowings occurred simultaneously. If so, a message is sent to the Balance Sheet report verifying the ability to pay the loans with existing cash. Then, verification of cash, loans and investments is made. In this case, a suggestion is made to analyze the possibility of paying the loans, even if the withdrawal of funds from the investments is required. It is expected that the student understands that the company's financial resources must be managed and that there is some risk in the process. In applying the funds to generate some income, the company can be left with a cash balance not sufficient to withstand fluctuations in demand. Hence the need for students to understand is cash flow and how it improves the quality of the decisions of the manager.

These warnings are expected to improve not only performance of teams in the game, but also their understanding of the concepts embedded in the model.

4. Data analysis and results

The data used in this study was collected from two specific games: one for postgraduate specialization degrees and one for master degrees. The group for the postgraduate specialization students consisted of two classes, one located in the region of Bauru, with 36 students, and one in Sorocaba, with 32 students, and the group for the master students was composed of a single class of 15 students, all from the region of Bauru. With the objective of presenting the possibilities of applying these indicators to support the teaching-learning process, we will analyze the characteristics of the financial resources of the company as reference for the success of decisions relating to loans, the challenge of decisions to buy and use installment sales with

capital requirements, and finally, the availability of cash.

The analysis of the consistency of decisions regarding the level of debt of the enterprises was carried out considering loan requests, with spontaneous and intentional decisions (Fig. 1) and occurrence of emergency credit (Fig. 2). The idea behind this analysis is that the loan request should avoid the occurrence of emergency credit, because it means that the financial planning company failed.

Figure 1 was designed to discriminate against companies that have opted to start their activities with the help of capital from a third party, without the desire to insinuate that they are more susceptible to a lack of capital, since the model uses the Virtual Market capitalization of the American system, i.e., companies pay interest at the end of the capitalization (plays/moves). The chance to borrow, especially in cases when the company is starting a business activity should regard the lack of working capital as a inherent risk, and not merely as a consequence of the project requiring funding.

Even in a simulated environment, this kind of logic is readily apparent because most of the companies that requested loans in the Masters Group were not able to rid themselves of the emergency credit granted when the projected needs of capital
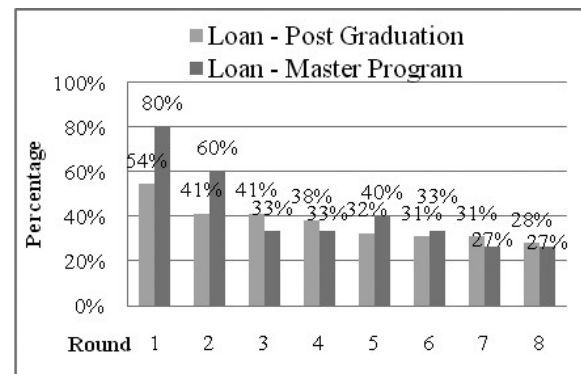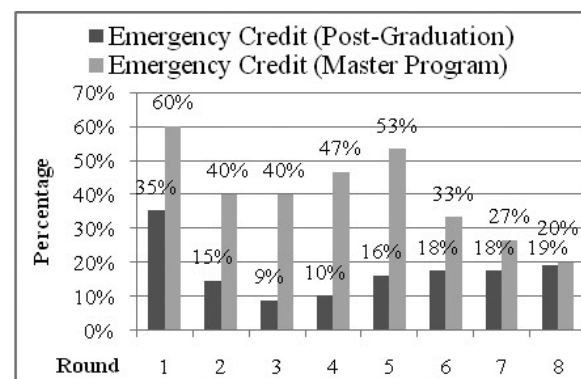

Fig. 1. Credit Solicitation.

Fig. 2. Emergency Credit.

failed and a loan at double the cost was granted the company, raising its non-operating expenses.

The high percentage of companies that began operations with third-party capital in the masters group reduced during the moves, the reverse of the situation is observed for the post graduation specialization group. Since both groups seem to have chosen to work with equity, at the end of the games the percentage of companies requesting loans was almost identical in both groups, indicating that there is some progress in learning about the financial management of enterprises and that most companies want to reduce dependence on third-party capital as time passes. The percentage of companies requesting loans fell from 80% in the first play to 27% in the last for the group and masters group and from 54% to 28% in the post graduation specialization group.

Figure 2 was designed to investigate the decisions concerning the loan as presented in Fig. 1. It shows that even for the fraction of the companies of the two groups that have requested loans, this action was not enough to rid them of the need for revolving credit, showing that financial planning was flawed.

Figures 3 and 4 were designed to examine the following scenarios: (a) firms that applied for loan and did not require emergency credit when the data was processed, i.e. the prediction of company performance and capital requirements were successful (Loan Success), (b) Companies that have requested loans, but missed its projected needs for capital and required extra credit (Loan failed) (c) Companies that chose not to apply for loans and did not require additional credit (Success without loan), and (d) Companies that did not apply for loans but needed extra credit (Fail without loan).

In the first round, the percentage of companies requesting loans (the sum of Loan Success and Loan Failed) and those not requesting (the sum Loan without fail and Success without loan) shows that the planning errors in firms not applying for loans in post-graduation group, while in the group of the Master Program the situation is the opposite. This may indicate that care should be taken in the development of indicators to guide learning in relation to this content, because this data may be indicating that these users have difficulties in various aspects of financial management, ranging from a lack of understanding of how the resources of third parties can be coupled to the company's strategy, to the lack of skills in planning for capital requirements. Both groups demonstrated a similar behave in relation to the 'Loan Failed' showing that learning is accomplished using the game. In the eighth round the two groups significantly reduce this error, 6% in the postgraduate specialization group and 7% in the master group. Likewise, the percentage of companies that do not apply for loans and are successful rises considerably and converge to 60% in both groups, also an indication of learning been achieved.

Data from the master group shows that more than half of companies were incorrect in their predictions of capital requirements (47%/80%). The opposite happened with those companies that decided there was not a need for capital and did not request a loan (13%/20%). Meanwhile, data for the postgraduate specialization group shows that more than half of companies were successful in their decisions, whether regarding the requesting of loans (31%) or not (34%). This data indicates that the postgraduate specialization group started the game with greater knowledge of third-party capital, financial management of operations and demand forecasting.

Looking at the last plays, the two groups began to show similarities. The percentage of companies requesting loans and companies not requesting loans was very close, 27% and 73% for the master group and 28% and 72% for the postgraduate specialization group. The success rate of decisions was quite similar too. For both, the success rate was around 82% for companies that did not apply for loans. In the post-graduation it was 81.9% (59%/72%) and in the master group it was 82.2% (60%/34%). The data also indicates that the master group
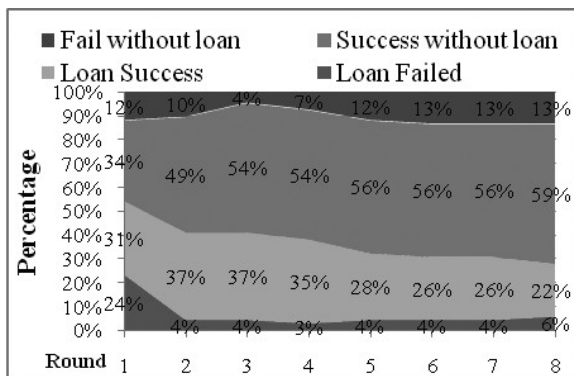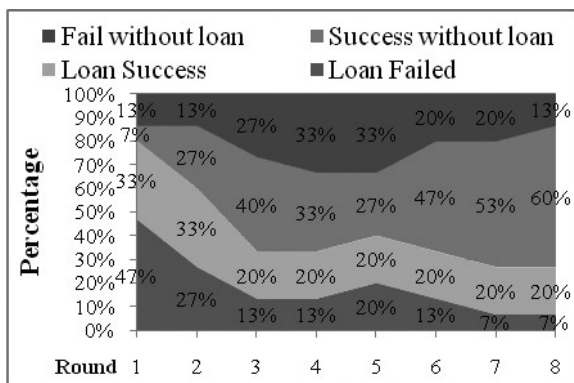

Fig. 3. Loans (Post-graduation).

Fig. 4. Loans (Master Program).

is more likely to reduce the company debt, but display less competence in forecasting techniques, for both company performance and capital requirements.

A trajectory analysis of the two groups shows greater stability in the decisions of the postgraduate specialization group than those of the master group, i.e. the success rate of the decisions without the encumbrance of loans fluctuated more for the master group with an average of 52% than that for the postgraduate specialization group that averaged 37%. This data demonstrates a characteristic that should be further investigated in Brazil: risk aversion, which may have resulted from a combination of a period of high inflation and period of reorganization of inflation with high interest rates. Even today Brazil has the highest interest in the world [40].

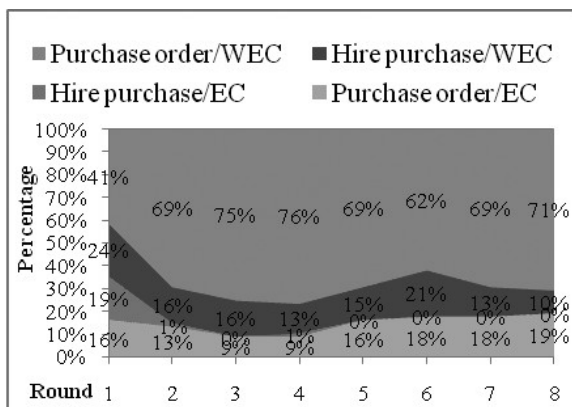The results presented in Figs. 5 and 6 refer to the following tests: (a) Purchases without installments
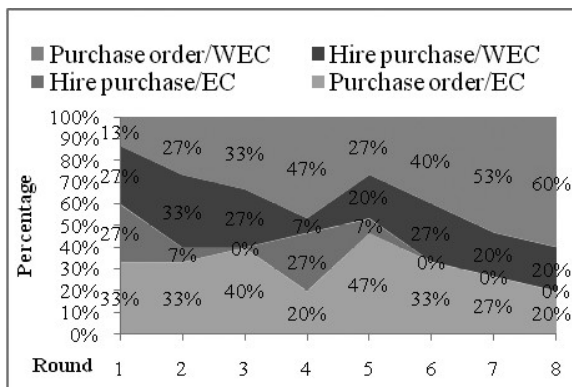
and without emergency credit (Purchase order/ WEC); (b) Purchases without installments and with emergency credit (Purchase Order/EC), (c) Purchases with installments but without emergency credit (Hire Purchase/WEC) and (d) Purchases with installments and with emergency credit (Hire Purchases/EC).

These data suggests that the postgraduate specialization group have a greater understanding of finance, reinforcing the analysis presented in Figs. 3 and 4, because the success rate shows that companies that make purchases using installments and do not require emergency credit, is far more superior for the postgraduate specialization group than for the master group. While the first group incurs an opportunity cost, forfeiting the income that could be generated by mid-term supply for the savings in interest payment, it has taken this decision with more accuracy than in the case of the master group.

The graphs also show that the high percentage of companies purchasing without installments and using emergency credit in the master group varies between 20% and 47%, %, Fig. 6, 'Purchase order/ EC'. This is strong evidence that there is a knowledge gap for working capital in this group. The table 2 illustrates what would happen to the two groups if the alert message 'cash without loan' were introduced to the games.

Observe that there are a large number of teams that receive the alert without take loans. Analyzing the two groups, the lowest percentage observed is 40% for the master group, and the largest, 91% (for the postgraduate specialization group). Previous data indicated that the postgraduate specialization group seemed to have more knowledge of financial management, however, Table 1 suggests that it is weak with regard to improving the profitability of the company, i.e., it seems that most teams in this group were focused on reducing the dependence of third-party capital and operating costs, but do not realized they could improve the profitability of the company by making a more appropriate allocation of funds.

The comparison of the decision of the players together with the result of processing them was used to identify situations in which the demand was greater than the production capacity. The number of inconsistencies per game were counted and transformed into percentages for presentation in Table 3.

Fig. 5. debt × purchases (Post-Graduation).

Fig. 6. debt × purchases (Master Program).

Table 2. Number of users who would see the message 'cash without loan'

Group	Play/Move								
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**
Specialization Group	65%	85%	91%	87%	82%	82%	82%	81%	81%
Master Group	40%	60%	60%	53%	47%	60%	73%	80%	67%

Table 3. Percentage of production decision is incompatible with the production capacity

Group	Move/Play								
	1	2	3	4	5	6	7	8	9
Specialization Group	38%	41%	51%	47%	50%	53%	51%	46%	43%
Master Group	27%	27%	33%	40%	53%	27%	27%	33%	33%

Table 4. Did the game challenge some of their management skills? What and/or which?

Did the game challenge some of their management skills? What and/or which?	Postgraduate		Master	
	Average	Median	Average	Median
Ability to make a decision	4	4	4	4.5
Production capacity planning	4	4	5	5
Ability to take risk	4	4.5	–	4.5
Formulating scenarios	4	4	4	4
Evaluating scenarios	4	4	5	4
Management of financial resources	4	4	6	5
Evaluation and understand the market and its trends	4	4	4	4
Formulating competitive strategies	4	4	6	5
Identifying the strategies for competing	4	4	–	3.5
Formulating countermeasures to competitors	4	4	–	4.5

Table 5. In short, what is your general opinion about the games?

Item	Postgraduate specialization	Master
Very good	10	2
Good	13	2
Regular	6	0
Weak	1	0
Grand total	30	4

The data in Table 2 demonstrates better command of the concept of production capacity by the master group. However, it also shows that the alerts for capacity would be served to at least 27% of the teams, regardless of the group they belonged to, or almost a third of users of the game would benefit by the inclusion of this feature in the system.

We analyzed the students' opinion about the game with a questionnaire of 10 questions [19], which were completed on the game site. Only the results of the first and eighth question are presented, because the first refers to the skills challenged by the game and the second, gives their opinion about the game. Students were allowed to assign grades of 0–6 for each of the skills. The questionnaire was answered by 30 postgraduate specialization students from a total of 68, and 4 of the master students from a total of 15. The results on the key managerial skills challenged are presented in Table 4.

The data suggests that of the 10 skills surveyed, all were highly challenging, since their median and average are equal to or greater than 4. This means that the grade 4 showed both the highest frequency in most cases (it was the most cited), but also divides the group into two equal parts in relation to the marks awarded. It should be emphasized that the master group had a higher frequency of 'managing resources' and 'formulating competitive strategies'. The results of the analysis of decisions coincide with the assessment of students as they show that there are flaws in managing financial resources, and it is a knowledge area that deserves additional attention. Table 5 presents the results on the students' opinions about the game. The survey criteria for this question were 'Very good', 'Good', 'Regular' and 'Poor'.

The results show that students' opinion of game is very good. One can argue that the data obtained from the game, whether this data is the decisions are stored in the database, or the data is obtained through questionnaires, represents the main characteristics of the skills and abilities of students.

The game can be also be used as a tool for competence assessment, reinforcing the theory of using indicators as a strategy to improve efficiency and effectiveness of the games. Moreover, they can be developed with reports for tutors and teachers, making the assessment and monitoring of students a simpler process, because it can be automated, at least in part. The efforts of the tutors and teachers can then be directed to individual or collective actions aimed at correcting deficiencies identified through the analysis of decisions.

5. Conclusion

The data presented in Tables 1 and 2 reinforce the proposal that it is possible to identify inconsistencies in the decisions of users of business games and simulations and this represents an opportunity to improve the performance of teaching resources/ pedagogy. In case of using the games in a classroom

and/or semi virtual environment, the indicators can be a point of reference for activities involving in-person discussions and analysis of data, making the meetings more productive. It is likely that users will be more motivated to initiate an investigation of the areas where they have struggled.

It would be premature to say that the indicators improve learning, but it is reasonable to think that they improve the conditions for learning to occur. From this position, it is proposed that it is possible to improve conditions for teaching and learning, especially in situations where the experience is almost entirely focused on the games/simulators and the environment that supports it.

From the perspective of teaching, many issues that do not come to the attention of the teacher, because the student is not able to articulate the problem or has not yet had the opportunity to be exposed to it, can be highlighted and discussed. And therefore, making it possible to improve the process of evaluation and feedback to the student. And from a learning perspective, the environment is enriched with features that assess various dimensions of the decision-making process suggesting possible causes of misunderstandings. Incorporating such a capability can be 'programmed' to direct students to study specific content, especially in areas where they are challenged.

Since the goal of the indicator is pointing out the inconsistency without giving a solution, the proposal is not in danger of turning the game into a simulator or instructional system, which would in the loss of the main feature of the system, the offering of active and experiential learning. An off-shoot of this research is now underway where the indicators are being studied from the perspective of the students.

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