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# Students' perceptions about the influence of educational games on achievement and motivation, a study based on the Flow Theory

# Percepciones de los estudiantes sobre la influencia de los juegos educativos en el logro y la motivación, un estudio basado en la Teoría del Flujo

# Percepções discentes sobre a influência de jogos educacionais na realização e motivação, um estudo baseado na Teoria do Fluxo

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**Abstract**

**Purpose**: The present study analyzed the influence of educational games on the perceptions of motivation and achievement of students in an Accounting and Cost Analysis course at a university in the South of Brazil.

**Methodology:** The students played a game followed by a questionnaire was applied to 32 (thirty-two) students. The applied game is called Space Race. The questionnaire applied was based on the Theory of Flow in order to capture the students' perceptions regarding the flow experience lived during the application of the game. The Flow Theory analyzes the mental state characterized by concentration and focus on an activity resulting in achievement and motivation, based on the balance between skills and the challenge faced. Quantitative data were treated using descriptive statistics and Kruskal-Wallis test.

**Results**: The results showed that the students felt a flow experience, with the dimensions of Clarity of Objective and Feedback being the ones that most contributed to this result. Other results were that: i) Immediate feedback motivated students who were marking right answers, but frustrated those who were wrong, ii) The competition from the game generated different reactions of anxiety to motivation in the students, and iii) Problems with the connection with the internet while performing the game reveal a technological barrier.

**Study Contributions:** The study contributes by: i) presenting the Flow Theory and its dimensions, a tool that can be used to measure student motivation and achievement; ii) when analyzing the students' perceptions regarding the application of an educational game; iii) by introducing a free game appropriate to the context of teaching in accounting.

**Keywords**: Flow Theory; Educational Games; Flow Experience; Student Achievement; Student Motivation.

**Resumen**

**Objetivo**: El presente estudio tuvo como objetivo analizar la influencia de los juegos educativos en las percepciones de motivación y logro de los estudiantes en un curso de Contabilidad y Análisis de Costos en una IES del sur de Brasil.

**Metodología:** Se aplicó un juego seguido de un cuestionario a 32 (treinta y dos) estudiantes. El juego aplicado se llama Space Race. El cuestionario aplicado se basó en la Teoría del Flujo con el fin de capturar las percepciones de los estudiantes sobre la experiencia de flujo vivida durante la aplicación del juego. La Teoría del Flujo analiza el estado mental caracterizado por la concentración y el enfoque en una actividad que resulta en el logro y la motivación, basado en el equilibrio entre las habilidades y el desafío enfrentado. Los datos cuantitativos se trataron mediante estadística descriptiva y Prueba de Kruskal-Wallis.

**Resultados**: Los resultados mostraron que los estudiantes experimentaron una experiencia del flujo, siendo las dimensiones Claridad de Objetivo y Feedback las que más contribuyeron a este resultado. Otros resultados fueron que: i) Lo Feedback inmediata motivó a los estudiantes que respondían las preguntas correctamente, pero frustraron a los que estaban equivocados, ii) La competencia del juego generó diferentes reacciones de ansiedad a la motivación en los

estudiantes, y iii) Los problemas con la conexión a Internet mientras se juega revelan una barrera tecnológica.

**Contribuciones al estudio:** El estudio contribuye mediante: i) la presentación de la Teoría del Flujo y sus dimensiones, una herramienta que se puede utilizar para medir la motivación y el rendimiento de los estudiantes; ii) al analizar las percepciones de los estudiantes sobre la aplicación de un juego; iii) mediante la introducción de un juego libre adecuado al contexto de la docencia en contabilidad.

**Palabras clave**: Teoría del flujo; Juegos educacionales; Experiencia de flujo; Logro estudiantil; Motivación del estudiante.

**Resumo**

**Objetivo**: O presente estudo teve como objetivo analisar a influência de jogos educacionais nas percepções de motivação e realização dos discentes de uma disciplina de Contabilidade e Análise de Custos de uma IES da região Sul do Brasil.

**Metodologia**: Aplicou-se um jogo seguido de um questionário a 32 (trinta e dois) estudantes. O jogo aplicado chama-se *Space Race*. O questionário baseou-se na Teoria do Fluxo com intuito de captar as percepções dos alunos quanto à experiência de fluxo vivenciada durante a aplicação do jogo. A Teoria do Fluxo analisa o estado mental caracterizado pela concentração e foco em uma atividade, tendo como consequência a realização e a motivação, baseando-se no equilíbrio entre habilidades e o desafio enfrentado. Os dados quantitativos foram tratados por meio de estatística descritiva e Teste de Kruskal-Wallis.

**Resultados**: Os resultados evidenciaram que os alunos vivenciaram uma experiência de fluxo, sendo as dimensões Clareza do Objetivo e o *Feedback* as que mais contribuíram para esse resultado. Outros resultados foram que: i) o *Feedback* imediato motivou os alunos que estavam acertando as questões, porém frustrou os que estavam errando; ii) a competição oriunda do jogo gerou reações diversas de ansiedade a motivação nos alunos e; iii) problemas com a conexão com a internet durante a realização do jogo revelam uma barreira tecnológica.

**Contribuições do Estudo**: O estudo contribui ao: i) apresentar a Teoria do Fluxo e suas dimensões, ferramenta que pode ser utilizada para mensuração da motivação e realização discente; ii) analisar as percepções dos discentes diante da aplicação de um jogo educacional; iii) introduzir um jogo gratuito adequado ao contexto do ensino em contabilidade.

**Palavras-chave**: Teoria do Fluxo; Jogos Educacionais; Experiência do Fluxo; Realização Discente; Motivação Discente.

## 1 Introduction

In view of the continuous and growing influence of technology in the behavior of current generations, the use of educational games becomes an important factor in learning (Falkembach, 2006; Santos, Tedesco, & Furtado, 2012; Savi & Ulbricht, 2008; Savi,

Wangenheim, & Borgatto, 2011; Silva & Moraes, 2011; Silva Neto, Santos, Souza, & Santos, 2013). Educational games aim to foster engaging experiences that convey a given knowledge, and the ability to measure these experiences is relevant (Kiili, Lainema, Freitas, & Arnab, 2014). One basis for measuring and analyzing the experience in games is the Flow Theory (Weibel, Wissmath, Habegger, Steiner, & Groner, 2008; Procci, Singer, Levy, & Bowers, 2012; Kiili et al. 2014).

Flow Theory analyzes the mental state characterized by concentration and focus on an activity, which, through the balance between the proposed challenge and the individual's abilities to perform it, results in a feeling of motivation and accomplishment (Csikszentmihalyi, 1997; Nakamura, & Csikszentmihalyi, 2009). The flow state then is achieved when the individual is highly immersed in their activities and feels intensely involved, and this is a positive and desirable state (Csikszentmihalyi, 1997).

Studies that have analyzed the use of educational games under the light of Flow Theory have denoted this theoretical approach as a useful tool in game-based learning investigations (Abrantes, & Gouveia, 2007; Jouan et al., 2020; Killi et al., 2014; Lucchesi, 2019; Santos, Gomes, & Silva, 2017; Silva et al., 2019; Tantan, Lang, & Boughzala, 2016). Therefore, the present study is justified in bringing the investigation of the use of educational games under the light of Flow Theory to the context of accounting education.

Given the above, this study presents the following research question: **In the perception of Accounting Science course students, do educational games influence their motivation and achievement?** It aims to analyze the influence of educational games in the perceptions of motivation and achievement of students of a subject of Accounting and Cost Analysis of a university in the South of Brazil.

Thus, this study aims to make contributions: i) by presenting the Flow Theory and its dimensions, a tool that can be used to measure the elements that most contribute to motivation and student achievement, and can be used even outside the context of educational games; ii) by analyzing the perceptions of students before the application of an educational game, highlighting which elements contributed to the motivation and student achievement during its application, and this analysis is performed both quantitatively (analysis of means, standard deviation and Kruskal-Wallis) and qualitatively, through open questions; iii) by introducing a free electronic game that fits the context of cost analysis teaching, and can also be used in other disciplines of undergraduate accounting (the game called Space Race).

## 2 Literature Review

### 2.1 Flow theory and educational games

Educational games are presented as a tool that can assist in the teaching and learning process by allowing students to learn through their own interactions with the game, so that those who play learn at their own pace with the support of a tutor in a playful way (Falkembach, 2006; Savi, & Ulbricht, 2008; Savi, Wangenheim, & Borgatto, 2011; Silva, & Morais, 2011; Silva Neto, Santos, Souza, & Santos, 2013). Educational games aim to create engaging experiences that convey a given knowledge, and the ability to measure these experiences is relevant (Kiili, et al., 2014). A model for measuring experience in educational games is provided by Flow Theory (Weibel, et al. 2008; Procci, et al., 2012). Csikszentmihalyi's Flow Theory (2003, 1999, 1992, and 1990) can be considered a significant benchmark when investigating the elements that assist in an individual's concentration when performing a given

task, i.e., what keeps them motivated during that process, and motivation is also investigated in research on accounting education.

Vendruscolo and Behar (2014) showed that one of the main factors influencing the teaching-learning process is the students' motivation. Also according to the authors, as for the teachers' competences, the following were listed as the main influencers on the students' performance: the updated mastery of the subjects taught by the teacher; the teaching techniques used; and the didactic resources used. These teaching techniques are instruments that aim to facilitate access to knowledge, stimulating the creation, motivation and innovation of students in their teaching-learning process (Moura, Quirino, Segantini, & Araujo, 2014). Educational games are one of these teaching techniques, and the Theory of Flow is a tool for measuring the motivation and achievement of students during their interactions with these games. This measurement of motivation and achievement occurs according to the example presented by Kiili et al. (2014) in Figure 1.

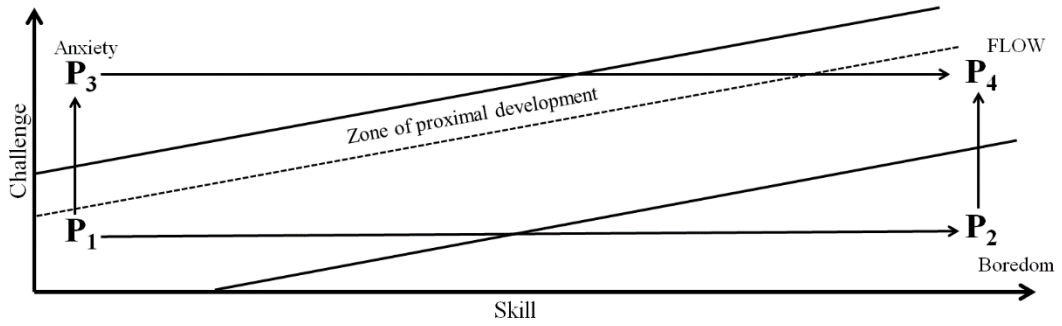


**Figure 1** *Model for capturing the flow state (balance between skill and challenge).*
**Source:** *Adapted from Kiili et al. (2014).*

In the model presented, when the player is a beginner, he is content with the challenge of performing the basic moves (P1). However, as his skills evolve, the player finds it boring to perform such basic moves (P2), leading him to seek skilled players to be his opponent. However, his skills are not compatible with the high skills of these players, leading him to a state of anxiety (P3). As such, when the player finds an opponent with skills compatible with his own (so that he can beat him, but with difficulty), then the player will reach the flow state (P4) (Kiili et al., 2014).

As a tool for measuring motivation and achievement when performing a given task, the Flow Theory is used in studies about educational games. These games developed specifically for educational and training purposes, called serious games, open up possibilities for studies on their effectiveness as an auxiliary method in the learning process (Crookall, 2010).

Studies that analyze the flow experience in educational games do so through the dimensions of flow, these being: concentration, clarity of objective, feedback, challenge, autonomy, immersion, social interaction, knowledge evolution, time distortion, rewarding experience, playability, loss of self-awareness, and sense of control. (Sweetser, & Wyeth, 2005; Killi, 2006; Fu, 2009; Kiili et al., 2014). The dimensions of flow are described in Table 1.

**Table 1**
*Description of the dimensions of the flow experience*

| Dimension | Description |
|---|---|
| Concentration | The game must stimulate the player's attention. By being focused on the activity, the player is not distracted by stimuli other than the game. |
| Clarity of Objective | Understanding what is to be done, as well as understanding the purpose of the game itself. |
| Feedback | The player needs to know how he is doing in the game, as instantly as possible |
| Challenge | It explores the skill/challenge relationship, as described in the example by Killi et al. (2014), as well as the development of the player's skills. |
| Autonomy | It deals with the player's independence, so he can use strategies based on his impact on the game. |
| Immersion | The player may be engrossed to the point where he or she stops paying attention to the events around him or her and focuses entirely on the game, even temporarily forgetting about the worries of everyday life. |
| Social Interaction | Play with other people, either as your opponents or cooperatively. |
| Evolution of Knowledge | The game should foster the application of the theoretical knowledge studied by the student, integrating theory with practice. |
| Time distortion | By being focused on the activity performed, the player can feel a change in his being of the passage of time (speeding it up or slowing it down). |
| Rewarding Experience | Upon completing the proposed objectives, players should feel rewarded, thus stimulating a rewarding experience. |
| Playability | The interface and controls should be intuitive, so that the player learns to interact with the game spontaneously and automatically. |
| Loss of Self-Awareness | The player may be so engrossed in the game that he doesn't care what his colleagues are thinking about his performance. |
| Sense of Control | The game must convey to the player a sense of control of his attitudes within it |

**Source:** *adapted from Sweetser & Wyeth (2005); Killi (2006); Fu (2009); Kiili et al. (2014).*

Silva et al. (2019) drew on Flow Theory to apply games to Portuguese Accounting and Marketing classes in order to investigate a possible improvement in the mental flows of focus and concentration of these students. Their findings evidenced that the use of games in the classroom process can reduce the boredom factor, increase intrinsic and extrinsic motivation and students' interest in learning.

A game called SEGAE, developed by Jouan et al. (2020), sought to assist in teaching agroecology. In their results, the authors evidenced that students who interacted with the game showed a significant increase in their knowledge about agroecology, especially those who had little knowledge about agricultural production. As for the flow experience, 86% of the students enjoyed playing SEGAE, with the Knowledge Evolution, Interaction and Feedback dimensions presenting the highest scores, while the Concentration and Clarity of Objective dimensions presented the lowest scores.

Tantan et al. (2016) applied a game called INNOV8 to master's students in Business Process Management. The students experienced the flow state, feeling involved and immersed during the application of the game. The dimensions with the highest mean scores were Challenge and Loss of Self-Consciousness, while those with the lowest mean scores were Playability, Concentration, and Sense of Control. The authors point out that their findings should not be generalized, as elements such as cultural differences may influence the student's flow experience.

Killi et al (2014) applied a game called REALGAME to ninety-eight students on the Corporate Systems course. Their results pointed out that students experienced flow study, with the dimensions with higher averages being Sense of Control, Clarity of Objective, and Challenge, while Playability, Feedback, and Rewarding Experience had the lowest averages.

The authors emphasize that using the dimensions of the flow experience does not provide detailed information about the shortcomings or highlights of the game itself. For this, it would be necessary to broaden the scope of research by encompassing in the investigations elements that address game mechanics and audiovisual implementations.

Abrantes and Gouveia (2007) applied a game to a class composed of children from five to seven years old. They found that these students experienced a state of flow in all the variables investigated, namely: concentration, curiosity, control, intrinsic interest, and time distortion. Furthermore, the authors point out that this positive correlation increases as the students experience the games.

A questionnaire was applied by Lucchesi (2019), in order to assess the flow experience and interest of two groups: one that was exposed to a digital educational game and another group that did not participate (control group). The results of the study showed that the students who participated in the game presented higher averages regarding the perception of flow state and interest. Also according to the author, the experience of flow achieved through the digital educational game promoted the interest of students in the content taught, since being in a flow study, the student focuses on the task, overcomes challenges and realizes his sense of control over the activity.

The aforementioned studies addressed students' perceptions of the application of educational games. Calabor, Mora, and Moya (2019), in turn, applied an educational game called Platform Wars Simulation to a sample of accounting teachers to examine their perceptions and possible barriers to the implementation of games in the classroom. Their results indicated low incentive and motivation for the use of games by teachers, despite the perception of the benefits of these tools in the learning process, reinforcing the relevance of studies that highlight the benefits of adopting games in the classroom.

## 3. Methodology

The present study adopted a quantitative approach. Data collection was carried out through the application of a questionnaire, whose main objective was to understand how educational games influence the performance and motivation of students, based on the Flux Theory.

The procedure for the application of the game was as follows: in the class prior to the application, an expository lesson was taught about sales price formation based on costing methods, and students were told that in the next class a competitive game with questions based on the theme presented in the expository lesson would take place. The game applied to the students is called Space Race, available at https://b.socrative.com.

Before applying the game to the sample of students, a pre-test was conducted with the game Space Race, which consists of answering questions formulated by the teacher. For each correct answer, the student's rocket (the figure that represents the student in the game) moves one space. When a student makes a mistake, the rocket stays still, as shown in Figure 2. The winner of the game is the student who gets more correct answers in less time. The students can see their performance in real time, and can even compare it to the other students. However, students cannot identify which rocket belongs to each player, because this identification is made through colors: before the game starts, each student receives a token with a color that should not be shown to the other classmates, so that students do not know the color of their competitors.

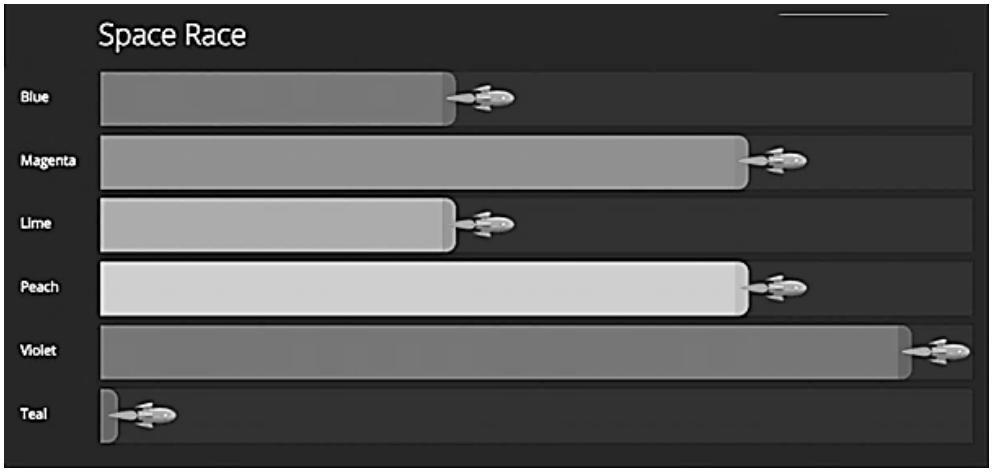


**Figure 2** *Example of the Space Race game interface display*
**Source:** *adapted from https://b.socrative.com*

On the day of the game, the first activity performed was the presentation and signing of the consent form by students. Then the students played Space Race, answering twenty (20) true or false questions about the theme presented in the previous class on sales price formation based on costing methods. The student who answered the most questions correctly would be the winner of the game. In case of a tie, the student who answered the most questions correctly in the least amount of time would be the winner. The game included prizes for first, second, and third place. After the application of the Space Race game, the students answered the questionnaire about the flow experience.

The questionnaire of this study, which is included in the appendix, was based on the studies of Kiili (2006) and Fu et al. (2009), which used a Likert scale of 5 points, where 1 (one) represents "Strongly Disagree", up to 5 (five) for "Strongly Agree". The questionnaire contained sixty-five (65) questions that sought to cover the following flow dimensions: concentration, clarity of objective, feedback, challenge, autonomy, immersion, social interaction, knowledge evolution, time distortion, rewarding experience, playability, loss of self-awareness, sense of control. After these questions, a short paragraph introducing the concept of flow experience was presented followed by a likert-scale question for students to express whether they experienced flow. Next, students answered three open-ended questions aimed at capturing their opinions about the game application. Finally, students answered questions to capture demographic data (age and gender).

The answers to open questions were organized and catalogued in Microsoft Word 2013®, and the answers of the questionnaires were tabulated in the Microsoft Excel 2013® software, serving as a basis for calculation of descriptive statistics (mean and standard deviation). Then, the Kruskal-Wallis test was performed, using the software StataMP 13, in order to investigate the influence of categorical variables gender, shift and age on the questions answered by students through the questionnaires. The results found were discussed along with the literature on the Theory of Flow in the application of educational games.

## 4 Data Analysis and Discussion of the Results

The application of the game and the questionnaire on the flow experience was carried out in January 2020. The study had a sample of thirty-two (32) students enrolled in the subject of Cost Accounting and Analysis. The students had ages ranging from forty-three (43) to

nineteen (19) years, with an average of twenty-two (22) years, enrolled in the Accounting course at a public institution in Southern Brazil. Of these students, 18 (eighteen) are female and 14 (fourteen) are male. Nineteen (19) students study at night, and thirteen (13) study in the morning.

First, an analysis was performed of which dimensions contributed most to the students' flow experience, i.e., which elements most promoted their sense of motivation and accomplishment. This analysis was based on the questionnaires answered by the students, using descriptive statistics (mean and standard deviation) for the Likert scale questions, as well as qualitative analysis of the open questions. Table 2 shows the means and standard deviations of the flow dimensions, captured by means of the questionnaire applied to the students after the game was played. The dimensions with the highest averages, i.e., those that contributed most to the students' flow experience, were Clarity of Objective, Feedback, Evolution of Knowledge, and Loss of Self-Consciousness.

**Table 2**
*Means and standard deviations of the flow dimensions*

| Dimension | Mean | Standard Deviation | Coefficient of Variation |
|---|---|---|---|
| Concentration | 4,02 | 1,01 | 25,21% |
| **Clarity of Objective** | **4,63** | **0,71** | **15,37%** |
| **Feedback** | **4,46** | **0,75** | **16,81%** |
| Challenge | 4,12 | 0,89 | 21,62% |
| Autonomy | 3,45 | 1,19 | 34,57% |
| Immersion | 3,70 | 1,12 | 30,21% |
| **Social Interaction** | **2,92** | **1,34** | **45,80%** |
| **Evolution of Knowledge** | **4,45** | **0,66** | **14,82%** |
| Time distortion | 3,67 | 1,02 | 27,68% |
| **Rewarding Experience** | **4,38** | **0,80** | **18,29%** |
| Playability | 3,80 | 1,23 | 32,32% |
| **Loss of Self-Awareness** | **2,91** | **1,54** | **52,93%** |
| Sense of Control | 3,50 | 1,03 | 29,45% |

**Source:** *Research data*

Throughout the application process, we tried to make clear how the game works. When its objectives are clearly explained to the player, the players can more easily concentrate on the proposed tasks (Killi et al., 2014), as reported by a student as a positive point: "the way the questions were elaborated, the ship chart and the eye-catching colors". Another student reported that objectivity contributed to his learning process: "the fact that the questions are more objective is easy for us to learn for practice".

Although Feedback was the 2nd (second) dimension with the highest average, some players reported that the immediate feedback frustrated them, as the following student reports: "very cool, but I played badly seeing my mistakes". On the other hand, for other players, the immediate feedback was mentioned as one of the motivators for the flow experience: "striving to do well every time I saw I got one more question right, motivation". These reports suggest that feedback helps students in the flow experience only when they are getting the questions right, frustrating them when they are getting them wrong. This result contradicts Killi (2006), who warns that when in flow, the player's reward should be the satisfaction provided by the activity itself, not their score.

The Knowledge Evolution dimension was the 3rd (third) with the highest mean. The application of games is a useful tool to assist the students' learning process (Falkembach, 2006;

Santos, Tedesco, & Furtado, 2012; Savi & Ulbricht, 2008; Savi, Wangenheim, & Borgatto, 2011; Silva & Moraes, 2011; Silva Neto, Santos, Souza, & Santos, 2013), as stated by one of the students about the positive points of the applied game: "development regarding the study of the content and details that make Cost Accounting more attractive and clear".

The 4th dimension with the highest average is the Rewarding Experience. This dimension is not necessarily about some kind of external reward to the student, such as an award, but rather a rewarding experience provided by the game itself. The flow experience is inherently rewarding, since by experiencing this feeling of reward, students are motivated to develop new skills that allow them to grow and ensure academic performance (Nakamura & Csikszentmihalyi, 2009). In other words, by overcoming the obstacles proposed by the game and being rewarded for it, the student feels motivated and fulfilled.

Araújo and Andrade (2011) conducted a study with two musicians in order to investigate which elements contribute for them to reach a flow study. The authors denote that the establishment of goals can contribute for the players to reach the flow state, because they help in managing the level of challenges faced. When the challenge is high and not commensurate with the player's abilities, the player may be driven into a state of anxiety (Killi et al., 2014). However, anxiety can hinder even when the level of challenge is compatible with the player's skills, as reported by a student: "I am an anxious person, playing makes me tense, this allowed me to miss a question that I knew, but I controlled myself and calmed down little by little. This account suggests that, even when the skills are compatible with the challenge, the pressure generated by the competition can hinder the player. As well as anxiety, other elements can prevent students from experiencing flow. Therefore, the present study continues with the analysis of the dimensions that contributed least to the players' flow experience, that is, those that presented lower averages.

With the exception of the dimensions Social Interaction and Loss of Self-Awareness, all other dimensions had a mean score above 3 (three). The score 3 (three) in the Likert scale questionnaire represented the 'indifferent' item, being the score 5 (five) 'totally agree' and the score 1 (one) 'totally disagree'. The low average in the Social Interaction dimension is justified by the fact that this dimension includes elements of cooperative games, and, as the game applied was played individually, there was little social interaction among players. The Loss of Self-Consciousness occurs when the player is so focused on the activity that he does not care what his colleagues will think about his performance (Kill, 2006). However, in the given study the players aimed to do well in order to overcome their colleagues, as one of the students said when he reported the factors that led him to a flow experience: "the motivation to answer right and first to see the ship go...". This account exemplifies the inference that the dimension Loss of Self-Consciousness presented a low average due to the fact that students did care about what their peers would think of their performance.

As for the standard deviation analysis, overall, little variation was observed among students' perceptions of the flow experience. Killi et al. (2014) points out that a collectively uniform experience (e.g., all players share a high level of concentration) helps players enter the flow state. The dimensions with the highest standard deviation were Loss of Self-Awareness (1.54) and Social Interaction (1.34). The Loss of Self-Consciousness (not caring what teammates will think about my result) and Social Interaction are dimensions more focused on the analysis of team games, which was not the case for the game applied in the present study. However, the students related these dimensions to competition with their peers.

Although it is not a dimension of flow addressed in the given study, 22% (twenty-two percent) of the players mentioned in the open questions the competition as one of the factors that influenced the flow experience: "the fact of being a competition for hits and time makes

you stay focused and achieve the best performance". On the other hand, some cited competition as a hindrance to the flow experience: "Without the competition we would have more time to think". While for some students competition hindered their flow experience, for others it is considered a motivator.

After analyzing how the dimensions contributed to the students' flow experience through descriptive statistics and open questions, the Kruskal-Wallis test was performed to investigate the influence of categorical variables (Shift, Gender and Age) on the questions answered by students through the questionnaire. This analysis sought to verify whether the shift in which the student studies, his gender, or his age influence his flow experience. To become a categorical variable, the variable Age was divided into 3 (three) groups: of students between 19 and 20 years old (n = 11), students between 21 and 22 years old (n = 12) and by students over 23 years old (n = 9).

**Table 3**

*Analysis of the influence of categorical variables by means of the Kruskal-Wallis Test*

| Categorical Variables | Questions | Prob |
|---|---|---|
| Gender | O1 - The general objectives of the game were presented at the beginning of the game (F:5.00 M:4.71) | 0,0695* |
| | F1 - I get feedback on my progress in the game (F:4,33 M:4,77) | 0,0988* |
| | F3 - I receive information about my success (or failure) of intermediate goals immediately (F:4.33 M:4.50) | 0,0919* |
| Shift | C9 - I had total concentration while playing (M:4.23 N:3.58) | 0,0502* |
| | P2 - I was not worried about my performance during the game (M:2.77 N:1.74) | 0,0528* |
| Age | C1 - The game catches my attention (A:3,64 B:4,42 C:4,89) | 0,0622* |
| | A1 - I feel a sense of control over the menu (like start, stop, save, etc.) (A:2.91 B:4.00 C:4.00) | 0,0611* |
| | A6 - I feel a sense of control over the game (A:2,55 B:3,58 C:3,59) | 0,0860* |
| | R2 - I enjoyed the feeling of playing and would like to play more often (A:4,18 B:4,75 C:4,89) | 0,0238** |
| | R4 - I found the experience extremely rewarding (A:3.82 B:4.33 C:4.67) | 0,0747* |
| | SC2 - I had a feeling of control of my actions (A:3.09 B:3.42 C:4.22) | 0,0477** |

**Source:** *Research data*

*Note: *means significant at p < .10; **means significant at p < .05.*

*Note: in parentheses are the means of the respective questions separated according to the categorical variable: Gender (F: female M: male), Shift (M: morning N: evening) and Age (A: up to 20 years old B: 21 and 22 years old C: older than 23 years old).*

The Kruskal-Wallis test showed that the categorical variables acted on some questions, that is, there is evidence that gender, shift (daytime or nighttime), and age influenced the students' perceptions of the flow experience. We then proceeded with the analysis of the means of the respective questions separated according to the categorical variable.

Gender influenced the answers of question O1 of the dimension Clarity of the objective and the answers of questions F1 and F3 of the dimension Feedback. In question O1, women presented higher averages, demonstrating that they had a greater understanding of the game objectives presented at the beginning. However, in both questions of the Feedback dimension (F1 and F3) men presented higher averages, demonstrating that receiving immediate information regarding player performance helped men to a greater degree to experience motivation and achievement through the flow experience. Hamlen (2010) investigated whether feelings of success and accomplishment when playing video games differ by gender. The results of Hamlen's (2010) study indicate that men have a higher perception of success and

accomplishment when playing video games, and that women have a lower interest in this type of technology compared to men. The author reinforces the importance of this type of study, given that stereotypes can drive women away from such technology.

The shift in which the student studies influenced the answer to question C9 of the Concentration dimension and the answer to question P2 of the Loss of Self-Awareness dimension. Matsuura (2008) investigated the difficulties faced by students who study Accounting Science at night. The author emphasizes the fact that most of these students work during the day and study at night, coming to class already tired. This argument may help explain the averages found in these questions, since both averages are higher for students from the morning shift when compared to students from the evening shift.

Age influenced the answers to six (6) questions, which comprise four dimensions: concentration, autonomy, rewarding experience, and sense of control. The results suggest that the Space Race game helps more students over the age of 23 to experience motivation and achievement through the state of flow.

The fact that the application of games in teaching was not something common drew the students' attention, as one of them said: "the fact that it was something different from what we do in the classroom, the focus and motivation were evident during the game". Besides not being common, some students reported the application of games as a methodology that puts less pressure on them when compared to the lecture class, as stated by a student about his experience with the game: "challenging and that puts less pressure on the student".

However, some students had difficulties due to problems with internet connection, as reported by a student about his experience with the game: "very good, very interesting and fun, only the internet crashed a little, but it was pretty cool". Killi (2006) emphasizes that even minor aspects that break the harmony and fluidity of the game can hinder the player's experience. Therefore, the use of the internet for the application of the Space Race game proved to be a technological barrier that should be taken into consideration by teachers who intend to apply this game to their students.

Calabor et al. (2019) reveals that the low use of games by teachers is related to the perception that there are few games suitable for undergraduate accounting subjects. However, some students considered the application of games a good alternative methodology, as one student quotes about his experience: "I liked it a lot, could have more games always at the end of each content applied". Other students also expressed the desire for more alternative methods, as reported by a student when explaining his experience with the game: "very good, we should adopt other alternative means of teaching and learning in university teaching".

The flow framework is a useful tool to assist in the analysis of game-based learning experiences (Killi et al, 2014). From this perspective, the following assumptions are made: a) the application of games positively impacts student achievement and motivation; b) competition divides opinion on being a positive or negative aspect; c) the internet can be a technological barrier.

## 5 Final Considerations

As younger generations play more video games, it becomes increasingly important that schools and universities take advantage of technology to help achieve positive results. This study aimed to investigate the influence of educational games on the achievement and motivation of academics in an Accounting and Cost Analysis subject at a university in the South of Brazil, from the perspective of the Flow Theory.

The results of the present study allow us to infer that, based on the perceptions of the learners, educational games positively influenced motivation and achievement. The dimensions with the highest averages, i.e., that contributed most to the motivation and achievement of students through the flow experience, were Clarity of Objective, Feedback, Evolution of Knowledge, and Loss of Self-Consciousness. These results highlight that for the student to experience flow it is necessary: i) to know clearly what should be done in the game; ii) to have immediate feedback to overcome their mistakes; iii) to have a perception of evolution of their knowledge, and; iv) there is a loss of sense of time passing.

The application of the game helped students to memorize the subject presented in a class previously taught by the professor. The idea is to open paths for research on the application of games in higher education classes, since the progress achieved in this area still leaves large gaps in the understanding of the effects of various active methodologies in the teaching and learning process on students.

Finally, it is the educator's job to create the conditions for uninterested students to become motivated, and to provide an environment that supports and optimizes the motivation of learners towards school activities so that they value them and want to engage in them. The motivation to learn must be stimulated by the teacher's permanent intervention through appropriate teaching strategies, and this requires the teacher to go beyond common sense. Thus, it is important that this new information be the object of reflection not only by the teacher, but also by the course department directors and the entire pedagogical coordination team, so that they can act in a single direction, making adjustments when necessary in the context of higher education in search of new alternatives.

Nevertheless, the use of educational games is not intended to replace traditional teaching models, but to present one more option so that the teacher can stimulate greater student involvement. We did not evaluate the game itself, the instrument, or the rules, but we did consider how it could be used as a complementary tool by the teacher. As a limitation, we highlight the fact that the sample of this research is small (n: 32), so the results cannot be generalized. Thus, it is suggested as future studies the expansion of this research, through applications in various subjects within higher education, as well as the analysis of the effects using other games.

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## APPENDIX

*Questionnaire with the dimensions and their respective questions*

| Dimensions | Questions |
|---|---|
| Concentration | C1 - The game catches my attention |
| | C2 - The game provides content that stimulates my attention |
| | C3 - No distractions from the task stand out |
| | C4 - I can generally stay focused on the game |
| | C5 - I am not distracted during tasks that the player should concentrate on |
| | C6 - The workload in the game is adequate |
| | C7 - My attention was focused entirely on playing the game. |
| | C8 - It was not an effort to keep my mind on the events of the game. |
| | C9 - I had total concentration while playing the game. |
| | C10 - I was totally immersed in playing the game. |
| Clarity of Objective | O1 - The general objectives of the game were presented at the beginning of the game |
| | O2 - Overall objectives of the game were presented clearly |
| | O3 - Intermediate objectives were presented clearly |
| | O4 - I understood the learning objectives through the game |
| | O5 - I clearly knew what I wanted to do and achieve. |
| | O6 - The objectives of the game were clearly defined. |
| Feedback | F1 - I get feedback on my progress in the game |
| | F2 - I get immediate feedback on my actions |
| | F3 - I get information about my success (or failure) of intermediate goals immediately |
| | F4 - I get information about my status, such as my score or level |
| | F5 - I was aware of how I was doing in the game |
| | F6 - I can tell from my performance how I am doing in the game |
| Challenge | D1 - I enjoy the game without feeling bored or anxious. |
| | D2 - The challenge is appropriate, neither too hard nor too easy |
| | D3 - My skill improves gradually as I overcome the challenges |
| | D4 - I am encouraged by the improvement of my skills |
| | D5 - The game provides new challenges at an appropriate pace |
| | D6 - I was challenged, but believed that my skills would allow me to meet the challenge |
| Autonomy | A1 - I feel a sense of control over the menu (like start, pause, restart, save etc.) |
| | A2 - The game supports my error recovery |
| | A3 - I feel that I can use strategies freely |
| | A4 - I feel a sense of control and impact over the game |
| | A5 - I know the next step in the game |
| Immersion | I1 - I forget the time passing while playing |
| | I2 - I am unaware of the environment while playing |
| | I3 - I temporarily forget about the worries of daily life while playing |
| | I4 - I experience an altered sense of time |
| | I5 - I can get involved in the game |
| | I6 - I feel emotionally involved in the game |
| | I7 - I feel deeply involved in the game |
| Social Interaction | S1 - I feel cooperative with other classmates |
| | S2 - I cooperate strongly with other classmates |
| | S3 - The cooperation in the game is useful for learning |
| | S4 - The game supports social interaction between players (chat, etc) |
| | S5 - The game supports in-game communities |
| | S6 - The game supports communities outside the game |

(continue)

(continued)

| Dimensions | Questions |
|---|---|
| Knowledge Evolution | I1 - The game increases my knowledge<br>I2 - I take the basic ideas of the knowledge taught<br>I3 - I try to apply the knowledge in the game<br>E4 - The game motivates the player to integrate the knowledge taught<br>I5 - I want to know more about the knowledge taught |
| Time Distortion | D1 - My sense of time changed (sped up or slowed down).<br>D2 - The way time passed seemed different than normal. |
| Rewarding Experience | R1 - I really enjoyed the gaming experience.<br>A2 - I liked the feeling of playing and would like to play more often.<br>R3 - The gaming experience left me feeling great<br>R4 - I found the experience extremely rewarding. |
| Playability | J1 - I could use the game's user interface spontaneously and automatically, without having to think.<br>J2 - The use of the user interface was easy to acquire. |
| Loss Of Self-Awareness | P1 - I was not worried about what others might be thinking about my game performance.<br>P2 - I was not worried about my performance during the game. |
| Sense Of Control | SC1 - I felt in complete control of my game actions.<br>SC2 - I had a feeling of control of my actions. |
| Flow Experience | FE1 - Read the description of the flow experience and answer the following statement: I experienced a clear flow experience during the game. |

**Source:** *Based on Kiili (2006) and Fu et al. (2009) questionnaires.*

**Note:** *The unit of measurement was the 5-point likert-type scale.*