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Future Teachers' Perceptions towards Incorporating Board Games to Teach Mathematical Skills in History Classes

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Literature has emphasized the value of multidisciplinary learning strategies and the necessity of educating students to solve complex problems. It also pointed out the importance of teacher's beliefs in their practices. The purpose of this study is to understand how future teachers recognize the board game Caravelas as a didactic tool to help elementary school students develop math skills in History and Geography Portugal (HGP) classes, in a multidisciplinary way. A board game intervention was employed in the study, and both quantitative and qualitative data were gathered from sixteen future teachers enrolled in the Didactic of HGP course during their third year of the Basic Education programme. Two questionnaires were used along with a focus group discussion. The findings indicate that this group of future teachers thinks Caravelas can help students achieve their learning goals in mathematics and HGP, as well as develop their reasoning, problem-solving, and social skills. Future teachers believe Caravelas can be used as a didactic tool to integrate mathematics into HGP subjects and support multidisciplinary learning.

Keywords: mathematics education, history education, geography education, modern board games, board game caravelas

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INTRODUCTION

The homologation by Dispatch nº 6944-A/2018, of July 19, of the Essential Learning of Basic Education (Canavarro et al., 2021), brought new considerations to the overview of curricular guidelines in Portugal. The different documents that make up this reference document were designed in conjunction with the 'Student profile upon leaving mandatory schooling' (SP) (Martins et al., 2017), and, thus, the backbone of the curricular contents of the different subjects is now common. This fact brings with it the opportunity to make the emergence of multidisciplinary activities even more relevant. It should be noted that Science, Technology, Engineering, and Mathematics subjects (STEM) are one of the main priorities for Education in the 21st century. When we talk about STEM Education, we are fundamentally focused on preparing students for their digital future (Stehle & Peters-Burton, 2019). The integration of mathematics education with history and geography subjects can promote multidisciplinary learning and enhance students' reasoning, problem-solving, and social skills (Assapun & Thummaphan, 2023; Yuecheng, 2023). However, the union of these purposes when we seek to create tasks that are, at the same time, engaging and motivational for students, is not always easy to achieve (Mršnik et al., 2023). Board games seem to be able to emerge as a response to this problem (Bayeck, 2020), as they have the potential to combine educational content with interactive and enjoyable game experiences (Nakao, 2019). In recent years, there has been a resurgence in the popularity and variety of modern board games (Balladares et al., 2023). These board games offer numerous benefits as a didactic tool in education (Noda et al., 2019). Studies have been showing that teachers believe that board games can enhance students' ability to communicate mathematically (Maffia & Silva, 2021) as they are required to articulate their approach, negotiate moves, and engage in discussions with their peers during the game (Bayeck, 2020). Board games also offer students an opportunity to apply their mathematical knowledge and skills in a practical manner (Balladares et al., 2023). By using board games that align with the curriculum, teachers can create a learning environment that is fun and engaging, leading to increased motivation and interest in mathematics (Noda et al., 2019).

Therefore, in this paper, we will focus on the articulation between the History and Geography of Portugal (HGP) subject and the Mathematics subject, taught in the 2nd Cycle of Basic Education (CBE; it corresponds to grades 5 and 6, students of 9 to 11 years old), through the board game *Caravelas* (Orey, 2013). Three fundamental pillars are related in this study: (1) Mathematics and HGP curricular guidelines have common foundations; (2) research indicates that there are multiple benefits to game-based learning for students' skill development; (3) part of the content taught in HGP is represented in the theme of the *Caravelas* game. In this sense and given that the development of mathematics skills is the subject of our interest, we want to understand how future teachers perceive the *Caravelas* game's potential to foster multidisciplinary mathematical skill development within the context of HGP. Consequently, this study aims to understand how *Caravelas* can help teachers of the 2nd CBE to apply mathematics learning contents in HGP classes, without compromising its learning objectives.

Theoretical Background

Board Games

According to Sousa & Bernardo (2019), there are three categories of board games: Classical or Traditional, Mass-market and Hobby Games. For Classical or Traditional it is understood that neither credit to the author nor any commercial rights are attributed; Mass-market games are defined as games that belong to companies and distributors of mass-produced games, with no special focus on the designers or the inventiveness of their ideas; Hobby Games are those that are owned by companies or private individuals, where it is highlighted the designer's originality while recognizing their work (Sousa & Bernardo, 2019).

Hobby Games are further subdivided into five subcategories (idem), namely: (1) Wargames, deep military simulations, usually, about historical battles; (2) Role-play games, adventures accompanied by a narrative, where players are characters within the story and make decisions along the way. Usually, cooperative games; (3) Collectible cards, games where players can buy or trade cards, to construct their decks; (4) Ameritrash, games that combine elements from role-play games and wargames. They prioritize themes over mechanics; (5) Eurogames have multiple ways to victory and a determinate ending, avoid randomness, with relatively simple rule systems, mechanics are prioritized over themes.

All subcategories of Hobby games, but specially to last one, Nicholson (2008) would call ‘Modern Board Games’. For him a board game is modern when it isn’t focused on the players elimination, instead it is when ends at some predetermined point and each player’s performance is measured. This fact allows that the experience of playing is stimulating for all players though all the game play. The waiting time for a player turn is smoothed, since that often, the actions of other players give something to do. It can be, for example, goods exchanges or negotiations. They have interesting decisions, in the sense that when a player needs to take a decision, he or she must analyze many options, given that there are many ways to win or to collect points. In fact, this “makes for a very replayable game as players can explore different paths each play” (Nicholson, 2008, p. 2).

This kind of board games are having a growth in the market like never before. Thousands of new board games are published every year, in an exponential growth of creativity with new mechanics and themes (Sousa & Bernardo, 2019).

Board games as an educational tool

Although concepts like gamification and game-based learning have become more and more popular in the last years and even though thousands of new board games have been released every year, the role of modern board games in education and education research is still understudied (Maffia & Silva, 2022). Some studies have been trying to address how modern board games stimulate different skills, such as critical thinking, creativity, computational thinking, and how they stimulate motivation to learn. Bartolucci et al. (2019) conducted an experiment with two groups, an adult group, and a group of children. The adult group consisted of experienced players and non-players,

while the children's group had an experimental group and a control group. The experimental group received training with modern board games for 26 hours, over two weeks, while the control group had traditional teaching classes. To test the hypothesis, Remote Association Test, the Alternative Uses task, the graphic test of creativity by Paul Torrance, the problem-solving inventory, and the Raven Matrices were used. The main conclusions of this study are that modern board games can have a positive effect on cognitive functions, particularly on the creative side. The results showed that experienced adult players scored higher than non-players in cognitive tests, and children who received game training also scored significantly higher than the control group. The study suggests that modern board games have educational potential and can stimulate cognitive skills.

In another study, to understand the nature and development of computational thinking in the context of strategic modern board games, Berland & Lee (2011) conducted a study with the modern board game 'Pandemic'. It explores the relationship between aspects of game design and computational thinking, as well as the social aspects of strategic games. The students were encouraged to talk freely during the game. The authors concluded that complex computational thinking can be developed spontaneously by playing Pandemic, and that strategic modern board games can promote computational thinking and increase participation in computational activities (Berland & Lee, 2011).

García-Roca et al. (2023) conducted a study with an adapted version of the board game 'Untold: Adventures Await You', with first-year high school student. The purpose of this study was to assess how a board game might be used as instructional resource to create narrative texts. As main conclusions, the study highlights the potential of board games as a teaching tool that can improve students' storytelling skills while preserving an enjoyable and stimulating learning atmosphere.

Assapun, & Thummaphan (2023) carried out a study to explore the application of game-based learning in the classroom, with the primary focus of the study was to examine how students' problem-solving skills in lower secondary schools are affected by learning through board games. According to the study, after taking part in board games activities, students showed improvements in their problem-solving abilities. This implies that using board games to teach problem-solving techniques can be beneficial.

In a more mathematics education-related study, Maffia & Silva (2022) discussed the research and findings related to the use of board games in mathematics education, specifically focusing on foundational number sense. The conclusions were made based on the analysis of past contributions to the workgroup about 'Early Years Mathematics', in the context of the Congress of the European Society for Research in Mathematics Education, about board games and the review of literature on the topic. The researchers identified the potential of board games in developing young children's number sense, particularly in the areas of pre-verbal, foundational, and applied number sense. According to the authors, there is evidence that board games can provide a context for challenging mathematical tasks and can be beneficial for the development of foundational number sense (Maffia & Silva, 2022). However, further research is needed

to understand the features of board games for developing and accessing number sense, as well as to develop teachers' education in analyzing games and exploiting their potential.

Teachers' perceptions about board games as a didactic tool

According to the research literature (Vogt et al., 2018), teachers who have participated in experimental interventions involving board games are generally enthusiastic about using them in the classroom. In this sense, enjoyment of board games may lead teachers to propose more challenging tasks and adopt an explorative approach. Some studies about the believe systems of teachers on the use of board games on class as showed that teachers have positive views about using board games in the classroom. Yükseltürk et al. (2022) concluded in their study that teachers believe that board games, such as Chess, Taboo, and Jenga, can be utilized as educational tools to enhance various skills in students. They included socialization, problem-solving, strategic thinking, psychomotor skills, verbal intelligence, and cognitive abilities as skills that in their view can be developed by playing board games. Initial training teachers also recognize the importance of hands-on and face-to-face interaction that board games provide, allowing students to learn and socialize with their peers (Barekat, 2023). This hands-on and interactive approach fosters a deeper understanding of the subject matter and promotes critical thinking, problem-solving, and collaboration skills (Barekat, 2023; Sousa et al., 2023).

In the Math class, Vogt et al. (2018) refers that for teachers the benefits of using board games in classes include fostering mathematical competencies in a fun and engaging way, providing opportunities for repeated mathematical activities, promoting peer learning and support, and allowing for individualized learning based on the needs of each student. Board games can also offer a structured learning arrangement and controlled time frame. Additionally, board games can help to challenge and empower all students, and can be used to target a wide range of mathematical competencies (Maffia & Silva, 2022; Vogt et al., 2018). There are also some challenges when using board games in classes. Teachers mentioned the large classes sizes and problems with classroom management as a challenge on the use of board games in classes (Yükseltürk et al., 2022). It is also of reference that the challenges include the need of time for set up and engage with the play, the requirement for appropriate game mechanics and presentation of the topic content in study, and the need for games to be suitable for individual learning needs (Vogt et al., 2018).

Curriculum guidelines

The Essential Learning of Basic Education for HGP and Mathematics, as mentioned before, have a common basis, the SP (Martins et al., 2017). This document following the guidelines from The Future of Education and Skills of OECD Education 2030 (OECD, 2016) that stablish what children must learn during the next decade. From this framework eleven areas of competence emerged in SP, encoded from A to J, of which we will focus on six, namely, B – information and communication, C – reasoning and problem solving, D – critical thinking and creative thinking, E – interpersonal relationship, F – personal development and autonomy, and I – scientific, technical, and

technological knowledge. Therefore, nowadays, there are three essential principles for Basic Mathematics Education in Portugal (Canavarro et al., 2021): (1) Mathematics is for everyone. All students must have the opportunity to experience mathematically rich and challenging learning; (2) Mathematics is unique, but not the only one. In our global world, Mathematics contributes, along with other areas of knowledge, to the integral formation of students; (3) Mathematics for 21st century, where Mathematics Education must be focused on being relevant to current times, with challenges clearly different from those made in the past. The learning contents of Mathematics curricula for the 2nd CBE is summarized in table 1.

Table 1
Learning contents of Mathematics in the 2nd CBE (Canavarro et al., 2021)

Math knowledge	Transversal math skills	General skills and attitudes
Algebra Numbers Data and Probabilities Geometry and Measurement	Problem solving Mathematical reasoning Mathematical communication Mathematical representations Mathematical connections Computational thinking	Skills: Critical thinking; Creativity; Collaboration and self-regulation Attitudes: Self-confidence; Perseverance; Initiative and autonomy; Valuing the role of mathematical knowledge.

Today, transversal mathematic skills and general transversal skills and attitudes are as learning contents as mathematical knowledge in the subject of Mathematics for 2nd CBE students, in Portugal. This fact allows that mathematics learning contents can be worked on in other subjects, like HGP, for example. In fact, in this last, the curricula guidelines tell us that multidisciplinary should be promoted. Its main objective is for students to understand the fundamental role that geography and history play in understanding the nation's physical and human qualities as well as its historical-cultural evolution, encouraging cooperation, inclusion, respect for variety, an appreciation of human rights, and an understanding of the planet's finite resources (DGE, 2018).

Analyzing HGP Essential Learnings document for 5th grade, we became aware that the study of Portugal in the 15th and 16th centuries is part of the contents of knowledge in this area. In this sense, students should be able to identify the main stages of the Age of Discovery; locate territories of the 16th century Portuguese empire, value cultural diversity and the right to be different and, also, they must be able to identify concepts like marine expansion, route, colonization, slavery, ethnicity, and migration (idem). In this topic, the C, D, E, F, and I competences from SP must be worked and developed, as well as the autonomy and accountability of students should be promoted.

The board game *Caravelas*

Caravelas is a commercial modern board game published in 2013 by Mebo Games. It is a strategic game about the Portuguese Age of Discoveries, where the players take on the role of Portuguese navigators who travel worldwide, discovering new places and/or collecting spices. To play, players don't need to know anything about Portuguese History, quite the contrary, players learn about it while playing. It's recommended for children aged eight years and over.

In this game, each player has a fleet of four caravels, represented in small individual boards. They depart from Lisbon and must follow the routes, being subject to the different sea currents. The number of movements in each round is dictated by the wind, represented in the wind cards. In these cards, there are numbers between one and three. Each player has four wind cards, they play the number of wind cards they wish, adding their numbers to establish the number of movements their fleet will dislocate. The goal of the game is to score points, which are obtained by delivering spices in Lisbon or by discovering locations.

Since there is no elimination of players during the game and decision-making is based on strategy, we can consider *Caravelas* a modern board game, and because it has multiple ways to acquire victory points, it avoids randomness, it has a pre-established end and its rules system is simple, according to the categorization of Sousa & Bernardo (2019), *Caravelas* is classified as a Eurogame.

METHOD

The main objective of this study is to understand how future teachers perceive the *Caravelas* game's potential to foster multidisciplinary mathematical skill development within the context of HGP. To do so, the investigation took place in three moments: an intervention with the board game *Caravelas*, the answer to a questionnaire to evaluate the perceptions of students (future teachers) on *Caravelas* as a didactic tool, and the realization of two focus groups. In one of the focus groups (abbreviated F1), an interview was conducted, and in the other (F2), a questionnaire about their game experience was applied, the 'Game Experience Questionnaire' (GEQ) (Ijsselsteijn et al., 2013).

Two sessions with the game *Caravelas,* of one hour and a half each, took place with all the students in the class of Didactics of HGP. The intervention with *Caravelas* was conducted by the second and third others After the exploration time of the game, students were asked to answer the questionnaire on '*Caravelas* as a didactic tool'. Afterwards, they were randomly assigned to one of the two groups (F1 or F2). Six students participated in F1, and nine students answered the GEQ. None of the students participated simultaneously in F1 and F2.

The ethical requirements of the European Federation of Associations of Psychologists (EFPA) were followed. The research team ensured that all respondents knew and accepted the principles of informed consent, voluntary participation, and confidentiality of their responses.

For the analyses of the quantitative data, the software SPSS (version 25) was used. For the analyses of qualitative data, the software MAXQDA Analytics Pro 2022 was used.

Participants

Sixteen students of the third year of the Basic Education undergraduate degree program from a university in the North of Portugal took part in this study, one male and fifteen female. Their ages range from 20 to 23, with an average of 21,8 years old. As third-year students, these students studied the curriculum guidelines of Mathematics and HGP for

the 2nd Cycle of Basic Education in other courses. After finishing the degree in Basic Education, these students may proceed to a master's degree that will allow them to be Kindergarten Educators or Primary School Teachers or 2nd Cycle Teachers (5th and 6th grades) of Mathematics and Natural Science or of Portuguese, History and Geography of Portugal.

Data Collection Instruments

Questionnaire on Caravelas as a didactic tool

To collect the data, we constructed a questionnaire based on adaptations from the literature with sixteen statements on a Likert scale, ranging from 1 to 5 (1: completely disagree; 2: disagree; 3: indifferent; 4: agree; 5: completely agree), and three open questions, to evaluate *Caravelas* as a didactic tool to help developing mathematics skills in HGP classes. The questions are listed in Table 3, together with the results obtained. For the open questions, they were asked what they think the positive aspects of using *Caravelas* are, what are the negative ones and from what ages they think the games can be used.

The information that comes from this questionnaire is presented according to the terminology S(student)n(number)Q1.

Interview Guide

As for the focus groups, a guide was developed for F1 with seven questions (see Table 2), based on the questionnaire of '*Caravelas* as a didactic tool', to allow a deeper understanding about students' opinions.

The terminology used to present the information from F1 is S(student)n(number)F1.

Table 2
Focus group F1 questions' guide

1. What do you think about *Caravelas*?
2. What mathematical learning content do you identify in *Caravelas*?
3. Can *Caravelas* be considered a problem situation that help develop problem solving skills?
4. Does *Caravelas* help students achieve learning goals in Mathematics? Which?
5. Does *Caravelas* help students develop logical-deductive thinking?
6. Does *Caravelas* help students develop dispositions to learn scientific content?
7. Does *Caravelas* help students to develop autonomy and initiative?

The Game Experience Questionnaire

For F2, the 'The Game Experience Questionnaire' (GEQ) (Ijsselsteijn et al., 2013) was applied, so we could better understand the personal experience on *Caravelas* by the students. Each GEQ item is answered on a Likert scale with a level of agreement from 1 to 5 (1: completely disagree; 2: disagree; 3: indifferent; 4: agree; 5: completely agree). The GEQ is divided into three sections: (1) Core module; (2) Social presence module; and (3) Post-game module. The first two modules aim to assess the players' thoughts and feelings during the game. The third assesses players' feelings after they played the game. The core module assigns scores to seven dimensions: immersion, flow, competence, emotion, tension, and challenge. There are five questions for each element. The social presence module seeks to investigate the psychological and behavioral

involvement of players with others, and it is divided into three subcategories: Empathy, Negative Feelings and Behavioral Involvement. The post-game module assesses how players felt after playing the game. This module is particularly important to understand when players decide to play voluntarily.

The terminology used to present the information from F2 is S(student)n(number)F2.

FINDINGS AND ANALYSIS

Results from the '*Caravelas* as a Didactic Tool' Questionnaire

A test was conducted on every aspect of the questionnaire with the aim of determining whether the responses were neutral or, more accurately, whether there was a feeling of agreement or disagreement with the questions. After a significant Shapiro-Wilk normality test, the non-parametric Wilcoxon test for one sample was applied with significance level of 5%. The results are presented in Table 3.

Table 3
Results on '*Caravelas* as a didactic tool' questionnaire

Test value=3

	Mean	Sd	Statistics test	p-value
1. *Caravelas* helps students achieve learning goals in the subject of History and Geography of Portugal.[a]	4.56	0.50	136.00	0.001*
2. *Caravelas* helps students develop social skills.[d]	4.63	0.48	136.00	0.001*
3. *Caravelas* helps students to develop the ability to solve problems.[d]	4.31	0.58	120.00	0.001*
4. *Caravelas* helps students achieve learning goals in Mathematics.[b]	4.38	0.60	120.00	0.001*
5. *Caravelas* helps students to develop communication.[d]	4.44	0.50	136.00	0.001*
6. *Caravelas* helps students develop logical and deductive thinking.	4.69	0.46	13600	0.001*
7. *Caravelas* helps students to develop their creativity.	4.13	0.78	78.00	0.002
8. There is not enough time during the school year to apply *Caravelas* in classes.[a]	2.38	1.36	33.00	0.114
9. *Caravelas* helps students to develop mathematical reasoning.	4.44	0.50	136.00	0.001*
10. *Caravelas* helps students develop curiosity to learn scientific content.[b]	3.88	0.93	62.50	0.007
11. *Caravelas* helps students develop self-confidence.	3.94	0.90	74.00	0.005
12. *Caravelas* helps students develop collaboration and self-regulation.	4.38	0.70	105.00	0.001*
13. It is difficult to manage a class using *Caravelas*.[c]	2.13	0.99	11.00	0.013
14. *Caravelas* helps students develop autonomy and initiative.	4.50	0.50	136.00	0.001*
15. *Caravelas* allows to work with students in a multidisciplinary way.	4.31	0.58	120.00	0.001*
16. *Caravelas* is only useful for studying specific contents.[a]	2.19	1.01	19.50	0.016

n=16; *p<0,001; Wilcoxon test for a sample after a significant Shapiro-Wilk normality test;
[a]Adapted from Koh et al. (2012); [b]Adapted from Can & Cagiltay (2006); [c]Adapted from Watson & Yang (2016); [d]Adapted from Watson & Yang (2016)

By observation of the results we can say that these future teachers strongly agree on four questioned aspects: (1) that *Caravelas* help students to fulfil the HGP learning goals (mean=4.56; $p<0.001$); (2) it helps students to develop social skills (mean=4.63; $p<0.001$); (3) it helps students to develop logical and deductive thinking (mean=4.69; $p<0.001$); and (4) it helps students to develop autonomy and initiative (mean=4,50; $p<0.001$). They agree on nine questioned aspects: (1) *Caravelas* help students to develop problem solving skills (mean=4.31; $p<0.001$); (2) it helps students to fulfil the Mathematics learning goals (mean=4.38; $p<0.001$); (3) it help students to develop communication (mean=4.44; $p<0.001$); (4) it helps students to develop creativity (mean=4.13; $p=0.002$); (5) it helps students to develop mathematical reasoning (mean=4.44; $p<0.001$); (6) it helps to create dispositions for learning scientific subjects (mean=3.88; $p=0.007$); (7) it help students to have more self-confidence (mean=3.94; $p=0.005$); (8) it helps students to develop collaboration and self-regulation skills (mean=4.38; $p<0.001$); and (9) it allows teachers to work in multidisciplinary way with their students (mean=4.31; $p<0.001$). These future teachers do not agree that is hard to manage a class with *Caravelas* (mean=2.13; $p=0.013$) and they do not think that *Caravelas* can only be useful for a specific topic (mean=2.19; $p=0.016$). Also, they can neither agree nor disagree about the insufficient time in the schooler year to use *Caravelas* on class (mean=2.38; $p=0.114$).

In the open questions, students recommend *Caravelas* to a minimal average age of 8,4 (median=8) when asked about the suggested age of players. As for the positive aspects in the use of the board game *Caravelas* in educational context, the students mentioned mathematical reasoning, critical thinking, creativity, collaboration, self-confidence, autonomy, and initiative as learning contents within the play of *Caravelas*. They also noted the ludic aspect of the game and the motivational factor. "*Caravelas* is a game that helps both children and older people to develop critical thinking, communication, and creativity." (S1Q1). "It helps to have critical thinking, develop imagination, reasoning, and autonomy." (S2Q1). "Helps with mathematical reasoning, history learning, and groups collaboration." (S10Q1). "Improves motivation, concentration, and dynamics among colleagues." (S16Q1). "This game is good for children to learn the various places in the world in a playful way." (S8Q1).

Only two students pointed that the use of the board game *Caravelas* in educational context can take too much time of the class and the management of class can be difficult: "Maybe for some teachers it can be too long a game." (S6Q1). "It is difficult to control students when they practice games." (S15Q1).

Results from focus group interviews

Numbers was the most widely recognized mathematical knowledge. This was mentioned in the definition of strategies, the management of wind cards, and the score of points. Data and Probabilities were also pointed out by two students and Geometry and Measurement by one: "Counting, sequence and numbers." (S5F1) All students identified mathematical reasoning and problem-solving as transversal mathematical skills. Two of them identified computational thinking and one recognized mathematical communication. The mathematical learning contents identified are listed in Table 4.

Table 4
Mathematics learning contents identified by the students in *Caravelas*

	S1F1	S2F1	S3F1	S4F1	S5F1	S6F1
Mathematical knowledge						
Geometry and Measurement				x		
Data and Probabilities	x			x		
Numbers	x	x	x	x	x	x
Algebra						
Transversal math skills						
Computational thinking			x	x		
Mathematical connections						
Mathematical representations						
Mathematical communication				x		
Mathematical reasoning	x	x	x	x	x	x
Problem solving	x	x	x	x	x	x
General transversal skills						
Self-regulation				x		
Collaboration				x		
Creativity						
Critical thinking				x		
Attitudes						
Valuing the role of mathematical knowledge		x	x	x	x	x
Initiative and autonomy	x	x	x	x	x	x
Perseverance				x		
Self-confidence				x		

Only student S4F1 mentioned three of the general transversal skills, namely, self-regulation, collaboration, and critical thinking.

"Computational thinking and reasoning. It develops the ability to solve problems." (S3F1). "Yes. Because it has several route options, it presents several countries, and it has several strategies to try to win. These different strategies make it easier to develop skills and create problem situations." (S5F1). "*Caravelas* can be considered a problem situation since the players have to score as many points as possible through Discoveries or bringing spices and raw materials to Lisbon and, for that, it is necessary to use the wind cards to reach the desired location. These cards can be considered a problem situation since your moves depend on them. This game helps to develop problem-solving skills because first the game offers different strategies. Even if the players have difficulties, they can always manage to reach the goal of the game, but each one at their own rhythm. As throughout the game we are always trying to see strategies to collect the points and take the spices and raw materials to Lisbon, it means that we are also practicing and developing the ability to solve problems." (S4F1).

In the process of playing *Caravelas*, all students are thought to develop autonomy and initiative. Most of them described the valorization of the scientific knowledge within the game and student S4F1 pointed to perseverance and self-confidence. "It helps, for example, in the areas of history and geography, because it makes them aware of countries and their raw materials and they may gain interest and disposition to learn these contents." (S1F1). "*Caravelas* helps students to develop autonomy as it is played

individually. It also helps to develop initiative since when playing they are proactive, evaluating the game, trying out their ideas and strategies." (S4F1)

When questioned about what they think about *Caravelas*, different answers came out. "First, I think *Caravelas* is a fun game, easy to play and that anyone who plays it will also enjoy playing it. In addition to being an attractive game due to its colors and images, we find several advantages in it. We managed to explore different areas of knowledge, develop skills and abilities, and develop multiple intelligences." (S4F1). "It's an interesting game., It is capable of handling knowledge from different disciplines, which is a plus." (S1F1).

Results of the Game Experience Questionnaire

In all dimensions of the questionnaire, a test was carried out to verify whether the answers were in the sense of indifference or whether there was, effectively, a feeling of agreement or disagreement with the questions. For non-significant variables in the Shapiro-Wilk normality test, a t-student test was performed. For the other variables, the Wilcoxon non-parametric test was performed for one sample. In cases where there were too many ties, the Sign test was used instead of the Wilcoxon non-parametric test. The values obtained are explained in tables 5, 6 and 7, respectively, for the Core module, the Social Presence module, and the Post-game module.

Table 5
Test results for mean/median for Core Module

			Test value=3	
Core Module	Mean	Sd	test statistics	p-value
Competence	4.31	0.39	10.12[a]	0.001*
Sensory and imaginative immersion	4.56	0.49	9.47[a]	0.001*
Flow	3.73	1.04	2.12[a]	0.067
Tension/Annoyance	1.11	0.33	0[c]	0.004
Challenge	2.76	0.38	-1.908[a]	0.093
Negative affect	1.58	0.74	0[c d]	0.008
Positive affect	4.64	0.55	9[c]	0.004

n=9; *p-value less than 0,001; [a] t-student test after a non-significant Shapiro-Wilk normality test; [c] Sign test for a sample where Wilcoxon test is not appliable; [d] The Sign test was calculated with a tie

As verified by a significant classification higher than "indifferent", the participants in the experience felt competent (mean=4.31; p<0.001), immersed in the game imagery (mean=4.56; p<0.001), and had positive affective emotions (mean=4.64; p=0.004). In approval of these facts, they did not feel tension or annoyance (mean=1.11; p=0.004) and didn't feel negative affective emotions (mean=1.58: p=0.008). On another hand, students did not feel challenged according to the non-significant classification in this element (mean=2.76; p=0.93), and fluency in the game is indifferent for the students (mean=3.73; p=0.067). Regarding the Social presence module, according to table 8, the element of empathy was significant (mean=4.65; p=0.007) and, therefore, it is higher than 'indifferent'. For Negative Feelings, the indifference is accepted (mean=3.02; p=0.007) and the behavioral involvement is bellowing the indifference (mean=2.82; p=0.04).

Table 6
Test results for mean/median for Social Presence Module

			Test value=3	
Social Presence Module	Mean	Sd	test statistics	p-value
Psychological Involvement: Empathy	4.65	0.44	45.00[b]	0.007
Psychological Involvement: Negative Feelings	3.02	0.76	0.00[b]	0.007
Behavioral Involvement	2.82	0.48	-1.15[a]	0.004

n=9; [a]t-student test after a non-significant Shapiro-Wilk normality test; [b]Wilcoxon test for a sample after a significant Shapiro-Wilk normality test

The Post-game Module presents significant values in all dimensions (see Table 7).

Table 7
Test results for mean/median for Post-game Module

			Test value=3	
Post-game Module	Mean	Sd	test statistics	p-value
Positive Experience	3.96	0.72	4,009[a]	0.004
Negative Experience	1.33	0.46	0[c]	0.004
Tiredness	1.28	0.44	0[c]	0.004
Returning to Reality	2.15	0.69	1[c]	0.039

n=9; [a] t-student test after a non-significant Shapiro-Wilk normality test; [c] Sign test for a sample where Wilcoxon test is not appliable

Students considered the experience positive (mean=3.96; p=0.004) and the negative experience result is in line with it (mean=1.33; p=0.004). They did not feel tired (mean=1.28; p=0.004) and did not consider it difficult to return to reality (mean=2.12; p=0.039).

DISCUSSION

Knowing teachers' perspectives is fundamental. Their attitudes and beliefs have a big impact on how they teach and how their students learn (Yükseltürk et al., 2022). Understanding teachers' perceptions can help us gain important insights into how well they comprehend educational subjects, how they plan their classes, and how they approach teaching as a whole (Ponte, 2020). This information can assist programs for professional development, help define educational policies and practices, and ultimately raise the standard of education. The students (future teachers) who took part in this study experienced pleasant affective responses, a sense of competence, and immersion in the game's imaginary while playing *Caravelas*. Negative affective emotions, such as stress or displeasure, were not reported. Participants exhibited notable empathy and found the experience to be beneficial. Therefore, we try to understand what the beliefs about the use of the board game *Caravelas* as a didactic tool are, to develop math skills of 2nd CBE students in HGP classes.

By analyzing the qualitative and quantitative data, which point in the same direction, we can conclude that this group of future teachers identified several positive aspects of using the *Caravelas* board game as a teaching tool. They agree that *Caravelas* is a useful tool for meeting learning objectives, both in HGP and in Mathematics. Furthermore, they consider it a useful didactic tool for the development of 'Student profile upon leaving mandatory schooling' general skills and attitudes.

More specifically, these future teachers consider that Caravelas can help to develop social skills, develop logical and deductive thinking, and develop autonomy and initiative, problem-solving skills, communication, creativity, reasoning, self-confidence, collaboration, self-regulation skills, and it allows teachers to work in a multidisciplinary way with their students. Similar perceptions were found in Maffia & Silva (2021).

Caravelas was considered a problem situation that helps students develop several math learning contents. The mathematical knowledge identified by students in *Caravelas* includes numbers, geometry and measurement, and data and probabilities. In addition, *Caravelas* was considered fun, attractive, and capable of dealing with knowledge from different subjects.

CONCLUSIONS

The study's findings suggest that future teachers see the board game *Caravelas* as a useful tool for achieving the math learning objectives in HGP classes. They all agree that *Caravela*s aids in the development of a variety of skills in students, including teamwork, problem-solving, and logical-deductive thinking. The game is also thought to be a tool for multidisciplinary work and social skills development. The time management and class management components of employing *Caravelas*, however, have drawn some consideration. For these students, playing *Caravelas* was neither tense nor annoying; instead, participants felt competent, absorbed, and filled with positive emotions. All things considered, the participants report favorable experiences, low levels of fatigue, and ease of readjusting to reality. Overall, the study indicates that these future teachers hold positive views of *Caravelas* as an effective educational tool for teaching numerical operations with reasoning, while also incorporating content on World Geography and Portuguese History.

Future work may investigate a wider range of participants and collect their viewpoints on the roles they expect to play in a board game class while students are playing. Also evaluating the game within the context of HGP classes at school, watching how the teacher behaves, student reactions, and what knowledge they get from the game.

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