

# *Gaia ABstraction Game*: Proposal for a Game to Mediate the Teaching of Object Orientation

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**Abstract**—*Abstract*—The use of games as a teaching resource is increasingly present in the classrooms, the game provides a pleasant and attractive to students in the pursuit of learning. This paper presents the application of a game as a tool facilitating the teaching-learning paradigm of Orientation to Objects. The major contributions of this paper are to: highlight the game *Gaia ABstraction Game*, that may be important in the wake of student interest; make the lessons interactive, dynamic and attractive; create an environment of cooperation between participants and serve as a stimulus for the development of the student.

**Keywords**—games; cooperative games; object orientation.

## I. INTRODUCTION

One of the biggest problems encountered by students in understanding the paradigm of Object Orientation is the lack of ability to understand a few basics, such as the meaning of object and abstraction. According Lima [1], the object is all that is apprehended by knowledge, and that is not the subject of knowledge, i.e. everything that is manipulated or manufacturable; everything that is perceptible by any of the senses, things, parts and Article sales, all that is known, thought or represented, as opposed to knowing, thinking or acting. Abstraction in turn, is the act of mentally separate one or more elements of a complex whole, which is its representation, can only be substituted mentally out.

The knowledge of Object Orientation is the key to the development system software development. Nevertheless, it is easy to understand these concepts. According to Guedes [2], the paradigm of Object Orientation is considered by many professionals somewhat complex and difficult to understand, because it is a paradigm that works a lot with abstraction and objects classification. Thus, mechanisms to facilitate such learning is necessary in order to help the teacher to transmit the contents, and the student to receive this information in a clear and objective, breaking the current model of lectures that shows little interaction between student and teacher.

The difficulties presented by the students in understanding the disciplines that are composed by the Object Orientation paradigm, such as: software modeling, database design, and programming languages Object Oriented motivated the search for mechanisms that facilitate this learning.

In this context, this paper presents the *Gaia ABstraction Game* creation, which aims to become an aid tool and an

understanding of Object Orientation as well as strengthen mutual cooperation among students and provide more interactive, dynamic and attractive classes. As a case study, we applied the game in the classroom and analysed throughout the use of quantitative survey from the students.

This paper is structured into the following chapters: Chapter II presents the related work, contextualizing them in relation to games, cooperative and meaningful learning; Chapter III were presented theoretical approaches that will be used in this article; Chapter IV discusses the use of the game *Gaia ABstraction Game* in teaching-learning of Object Orientation; Chapter V deals with the case study of the instrument application; in Chapter VI the case study results showdown was effected; finally, the chapter VII presents the conclusions and future work.

## II. RELATED WORK

By observing the work-themed games as a mechanism to facilitate learning, it could be seen several works dealing with this subject in different areas within the educational context. In Netto [3], it was used the *AlfaGame* game as a tool to aid in the literacy process. According to the author, the game urged the students to learn the related content - Portuguese language and Mathematics - in a fun and attractive way through the game's challenges.

Quadros [4] used the game as a tool to support learning programming. According to the author, the students felt that the games helped them to learn programming, because they enabled the blending of creative work with logic, making it easy to transform ideas into a code and improving the acceptability of the challenge of programming.

Silva [5] shows how to use the game as a tool to facilitate the teaching and learning of mathematics. The author proposes a study of a working method that allows to stimulate learning of the integers by means of games, and in turn, Kimura [6] proposed the use of a tool set at work as negative numbers.

Some more work were found on games as a support tool, however no work researched addresses the game techniques with the goal of contributing to the teaching and learning Object Orientation.

### III. THEORETICAL FOUNDATION

In this chapter, we present the main concepts used in this article, such as: Meaningful Learning, Games and Cooperative Games.

#### A. *Meaningful Learning*

With the rising growth of social networks, and the emergence of new technologies, the current model of learning is no longer sufficient to motivate students to understand some important concepts to related disciplines.

According to Santos [7], the learning model that supports the needs of our time is no longer the traditional model that believes the student should receive information and be ready to operate a single task and fully repeat it. The promotion of meaningful learning is based on a dynamic model, in which the student is taken into account, with all their knowledge and mental interconnections.

The Ausubel is fundamental premise is: "The meaningful learning occurs when new information is acquired through a deliberate effort on the part of the learner to connect new information to relevant concepts and propositions into existing cognitive structure" [8].

To Ausubel [8], the learning process can be between the extremes of rote learning and meaningful learning. The rote learning is related to learning new information, with little or no association with any relevant concept in student cognitive structure, which simply receives information and stores it so that it remains available for a certain time interval. In the absence of other information that will serve as a combination, that remains in the cognitive structure as static form; this type of learning occurs when new information is seized without interacting with relevant concepts in the cognitive structure.

As for Pozo [9], the process of trying to assimilate or understand new situations is not only a growth or expansion of such prior knowledge, but also as a consequence of these imbalances or conflicts between prior knowledge and new information.

Meaningful learning, which is based on existing information in cognitive structure, is considered by Ausubel idea as anchor or subsunçor. The subsunçor is a specific structure, whose information can be integrated into the human mind, which is highly organized and holds a conceptual hierarchy therefore storing previous experiences of the student. Thus, the new information can interact to contribute to the knowledge transformation into new knowledge dynamically, thereafter relate new information and relevant aspects of the individual's cognitive structure. In other words, it can be said learning occurs when significant new information is anchored in the relevant pre-existing concepts in student cognitive structure.

To Moreira [10], Ausubel argues that each academic discipline that has an articulated structure hierarchically organized concepts, constitutes in a system of information. It is believed that these structural concepts can be identified and taught to a student to conclude in a system of information process.

#### B. *Games*

The game is conceptualized by many authors as a rich and differentiated, which allows the individual the ability to produce and transmit knowledge, making those involved in the game interaction process to accumulate knowledge and to have a distinctive intellectual and cultural enrichment. The game provides incentives for learning while articulating knowledge and skills, also brings the ability to make individuals seek satisfaction to their desires and needs. Thus, the game can contribute as means to facilitate the teaching and learning of students with difficulties.

According Netto [3], the games are educational tools available for the teacher to use in their classes, making them more attractive and dynamic.

The game insertion in the classroom aims to enrich the educational practices with creativity and resources to facilitate the acquisition of knowledge by students, Andrade [11]. Souza says [12], the games have the advantage of passing information in a more fun and interactive and are set in a playful environment linked to entertainment.

According to Freire [13], in the school education context, the game proposed as a way to teach content to students is very close to the pedagogical work. This is not another game, it is a game turned into a tool for learning.

Already, Soler [14] argues that in the game, there is always a new character, which is crucial to interest the student, making it one of the most conducive to the construction of knowledge. The game creates rewarding and attractive environments to serve as a stimulus for the student development.

#### C. *Cooperative Games*

Cooperative games are, by essence, competition trigger, but never neglecting the mutual cooperation between participants. Cooperative games have extraordinarily rich contexts that develop personal and social life.

When playing cooperatively, participants can express themselves authentically and spontaneously, as someone who is important and has values, primarily because of who he is and not of one achievements. Cooperative games allow the creation of an educational environment to teach young winning or losing does not matter, the important is to get everyone working towards a common goal.

Brotto [15] and Soler [14] define cooperative games as a play in which participants engage each other but not against each other, seeking to overcome challenges, share knowledge, awaken the courage to take risks thus little concern with failure or success, to enhance mutual trust and authenticity among participants.

According to Correia [16], a play set is an activity that provides constant and dynamic situations which stimulates creativity and expressiveness of the young whereas cooperation refers to the young people involvement and participation in games, it shows increased collaboration, solidarity, friendship and respect among participants.

To Amaral [17], cooperative games are activities that require teamwork in order to achieve mutually acceptable goals. The cooperative game seeks to harness the conditions, capacities, qualities or skills of each individual and apply them in a group, trying to achieve a common purpose. The most important is the collaboration of each, it is what one has to offer at the moment, so the group can perform efficiently the set tasks. According to the author, all participants, rather than compete the activity, aspire one common goal: to work together by combining their different skills and unite their efforts in order to accomplish a certain goal.

#### IV. USE OF GAIA ABSTRACTION GAME IN TEACHING-LEARNING OBJECT ORIENTATION

Assuming the students' difficulty analysis in assimilating and understanding the Object Orientation paradigm, as well as the teacher to convey that content in a dynamic and interactive, the *Gaia ABstraction Game* was created in order to facilitate this learning process. By characteristics, the game, in essence, brings mechanisms to foster an environment that enables planned and motivating various learning skills, that adds these features to the cooperative games particularity, and brings as main characteristic the mutual cooperation among the participants. Placed in the context of meaningful learning, the game *Gaia ABstraction Game* becomes a great tool in the Object Orientation knowledge development.

The game *Gaia abstraction Game* was developed using client-server architecture, and supports up to thirty-five students playing simultaneously. The server is installed on the teacher's machine, who will manage the entire system, such as: to set the level of the game difficulty, since it has three gameplay levels; to view the game remainder and your score and to give the match kick off after all participants connected to system. The Server was developed using the programming language *C #*. The students working environment (*Client*) was developed using the flash tool. The workstation connection to the student server is done through the teacher's machine IP (*Server*), and the student must be identified with his/her name and enter the Server IP. Fig. 1 and 2, shows the client-server architecture layout and interface connection station (*student*) with Server (*teacher*). The system uses all the language *ActionScript 3*.

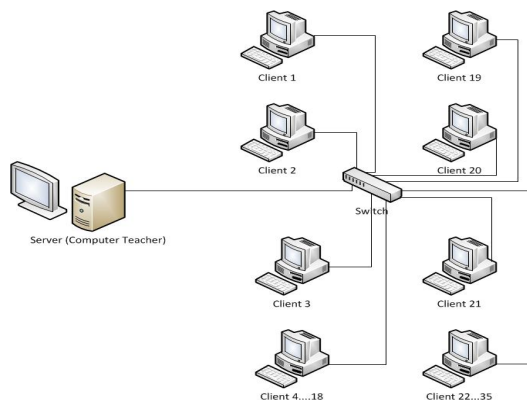


Fig. 1. Architecture *Gaia ABstraction Game* (Client-Server)



Fig. 2. interface connection station student.

##### A. Start Game

So to the game get started, you need a minimum of ten players. The game has seven rooms, and each is related to a business in which will be patterned during all phases of the game. These rooms will be released as the number of players, and with the participation of ten students the game will release three rooms, and for each five extra new participants, the system releases another room. Before the game starts, the teacher should set up the degree of difficulty that may vary from entry level to advanced. This will depend on the players knowledge level of the Object Orientation paradigm.

When all players are connected to the game, the teacher will give the start, and it is going to appear in the student interface a message with countdown time of five seconds for everyone and the receipt of the letters, we can from this moment the game time is already running and it will appear in the student interface, a clock with the match remainder. The game will last 1h and 20min, and may end up with the completed tasks by the working groups. We note the tasks will only end when all of the group achieve their goals.

##### B. Fase do Jogo

The *Game ABstraction Gaia* includes throughout its knowledge phases of Object Oriented paradigm, such as abstraction of objects, creation of classes of objects; definition of what an object is, the definition of relationships (inheritance, composition and aggregation) classes, and the cardinalities of relationships and stereotype. For the same contemplated characteristics, we created a mechanism composed of letters and boards.

When the game starts each student receives a letter that represents a class of objects (mold). The card is the major component of the game, its development surrounds attributed abstractions, methods and relationships that happen between these objects classes. Upon receiving these cards, students must locate the businesses that will be composed by them, which represent the gaming rooms.

To able the students to understand each business (software requirements to be developed) in question, and enter the correct room of your respective letter, it was developed Business

Letters which have a brief description of the requirements that make up the business in question. In Fig. 3, you can view the rooms desktop choice and business description of a specific room.



Fig. 3. Environment choice of rooms for the students.

However, the room choosing process is not as simple as it seems because it requires the student to read every business the system released and interpret correctly, so you can associate the letter to the business in question. One of the challenging factor the game provides the learner with the room selection: some letters may be used more than in one business, for example, the card maker can be used both in business dealer, Pharmaceuticals and in business. The student can read every business. He or she must click once on the business icon.

The highest level of the game is inside the rooms, it is in this environment the student begins to exercise his or her knowledge in Object Oriented paradigm. In this phase, the student must define the attributes and methods related to his card. The game brings in its initial configuration a list with several attributes and predefined methods and only some are accurate, others are on the list. Not only to create volume, but also to provide a further challenge to the student, as several attributes and similar methods, it differs only by a few characters (accents, cedilla and spacing), and these denotations evade nomenclature rules of attributes and methods. In Fig. 4, one can visualize the environment inside the room.



Fig. 4. Environment inside the rooms.

After the player fulfill the abstraction tasks of the attributes and methods, the player must click on the tray icon located below the right side of the screen methods, which will appear the student's card and the letters of the other players in the group, in this case Business dealership workgroup.

The board was developed to facilitate the classes of objects organization (cards), and each room has a tray for its specific business. The final game phase takes place within these boards, through which students begin learning a few important concepts of Object Orientation, the concepts of relationship (inheritance, composition, aggregation and bidirectional) and cardinality.

After the placement of all the cards on the board, the students begin to see which classes of objects (cards) related to each other, and how often these objects will relate between them. This is a crucial time of the game, since these concepts are difficult and complex, and extremely important that students communicate to exchange ideas and reach a consensus on this relationship and cardinality that happen between these classes of objects. In Fig. 5, we can see how this board is made.

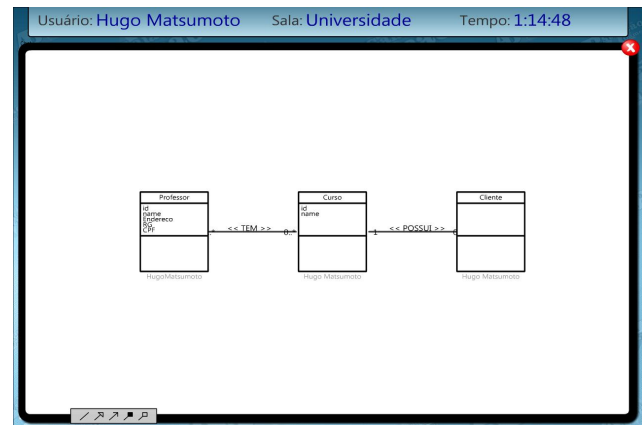


Fig. 5. Board of University Business.

The cardinalities, as most UML modeling tools and DER are already pre-set ((1,1), (1, n), (n, n)), only falling to specify the correct students, as the relationship defined by him. The student also must specify the stereotype of relationships, since the stereotype possible certain degree of extensibility associations (relationships), and allow the identification of these associations. The stereotype in the game *Gaia ABstraction Game*, follow the denotation of UML plotted between << >> (two signals and two lesser largest), which should be described on top of the online relationship. In the initial version of the game, the stereotype has the task of facilitating student understanding with regard to the relationship between classes of objects (cards), e.g. Class (class objects) has << >> (relationship) Student (class objects).

### C. Comunicação do Jogo

If the computer game is considered cooperative, it must foster an environment in which participants can work independently and enable the organization into groups to achieve a common goal. For the tool to enable such cooperation, some items are needed such as multi-player

support and enable communication between the participants. According Arriada [18], communication is essential to show cooperation among the participants. Communication during the development of the game *Gaia ABstraction Game* is therefore a fundamental requirement.

Every game *Gaia ABstraction Game* communication happens through the chat, to urge players communicate from the start of the game until its conclusion. In the game, the chat is divided into two types, the general chat, in which all players communicate with each other, this mode is only used at the beginning of the game for players to talk until everyone finds their respective rooms. After entering the room, the players start to use a unique to each room, as from this point in the game, each group tries to complete the game steps accurately to achieve the common goal to win the game.

If players must achieve the goals of the game, all students need to fulfill their roles in the game. The chat allows players with greater difficulty to perform tasks. They can receive tips from other students in the group. Students can give tips on how to do without perform another player task, once again, that the game does not allow the exchange of cards. One can see in Fig. 6, environment of chat.

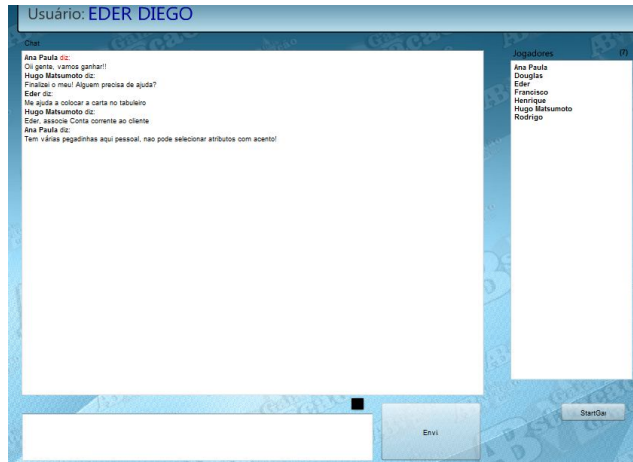


Fig. 6. Environment Chat.

## V. CASE STUDY

As a way to verify and validate the game application in the teaching and learning of Object Orientation, it was applied in model software class in two stages: at first, we explain the concepts of Object Orientation, giving emphasis on the construction of classes of objects (abstraction, object, class, attributes, relationships and so on.) secondly, it was explained, in general, the game operation and its goals.

The game was applied in five internet computer technician course classes, and at first, the participation of about 100 students aged between 15 and 19 years old. At first, the game was applied within classes, and working groups were composed by only students of their respective classes. After, the game was implemented with the participation of 35 students, simultaneously, to test the level of cooperation and

integration the game provided to students, students from five different classes participated in this event.

A questionnaire was used as a tool for proving the improvement of teaching-learning paradigm of Object Orientation provided for their own characteristics. It has the speed advantage and may include all students point of view who participated in the game. At the end, students were asked to fill out the questionnaire. It was composed of (15) fifteen questions to demonstrate contribution degree the game *Gaia ABstraction Game* brought to the player and the knowledge of Object Orientation.

## VI. RESULTS

According to the opinion analysis results the students submitted the questionnaires, it is possible to conclude that the use of the *Gaia ABstraction Game*, in a preliminary analysis, means and contributes positively to the understanding of the concepts of Object Orientation. Importantly, most of the students who participated in the study considered the game contribution positive.

At first, the instrument was administered to students at the technical level who had had contact with the Object Oriented paradigm to analyse the degree of contribution the game provided.

By questioning the students, who had contact with game *Gaia ABstraction Game*, in the means of learning Object Orientation. Of the 100 students surveyed: 43% said that the game contributed fully; 50% said that the game contributed partially; 7% chose not to respond. See the graph in Fig. 7.

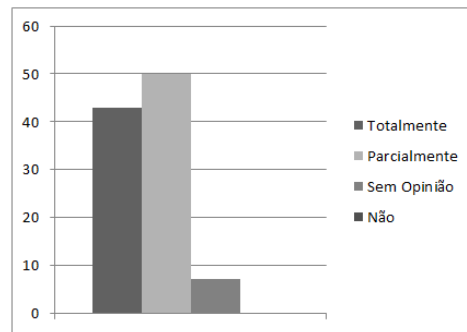


Fig. 7. Histogram shows game *Gaia ABstraction Game* contribution in the teaching-learning of Object Orientation according to the questionnaire.

Students who responded the game had partially contributed to the teaching-learning 8% answered the it contributes between 10-30%, and 48% of students responded the game contributed between 40-60%, while for 44% of students answered the game contributed between 70 and 90% according to Fig. 8 graph.



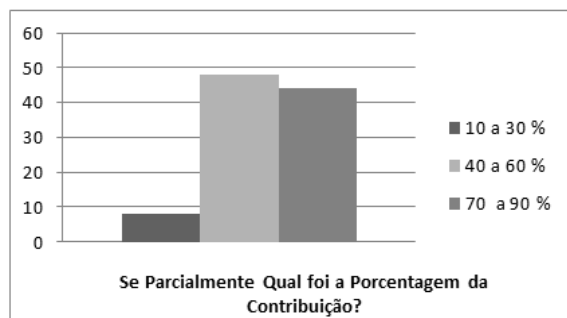


Fig. 8. Histogram showing the partial contribution percentage of *Gaia ABstraction Game* to the process of teaching and learning.

The vast majority of students responded that the game contributed fully or partly learning in the present study. It was asked what was the game *Gaia ABstraction Game* contribution in the learning of the basic concepts of abstraction, object, class of objects and relationships. See the graph in Fig. 9.

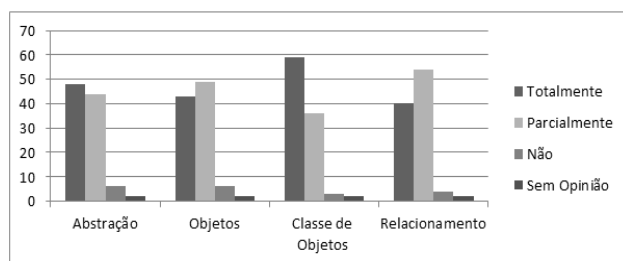


Fig. 9. Histogram with the contribution percentage game *Gaia ABstraction Game* provided in the learning of basic concepts of abstraction, object, class of objects and relationships.

When asked if game *Gaia ABstraction Game* provided an environment of mutual cooperation between the participants of the working groups, 88% of students answered yes, and 12% said that the game did not provide an environment of cooperation among participants. See the graph in Fig. 10.

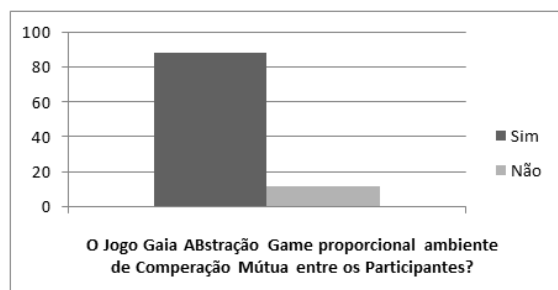


Fig. 10. Histogram with the students percentage who responded the game *Gaia ABstraction Game* provided an environment of mutual cooperation among the participants.

## VII. CONCLUSION

One of the main difficulties in computer courses - mostly in conceptual disciplines such as: Software Modeling, Analysis

Theory and Database Design - is to ensure the motivational factor for the students. After students enrolling in these courses, they bring along a work mentality and study based on repetition and memorization of concepts and content, without the worry of abstracting the knowledge acquired in solving problems.

With the attempt to awaken the motivating factor, and to stress the importance of studying these disciplines, it is proposed the use of a game as a mediator of learning methodology of these disciplines.

Thus, this article contextualized, throughout its development, the games that have already been applied in other areas of education, stressed the importance of cooperative games and its meaningful learning. Finally, to facilitate this strategy, it was implemented a game with practical scenarios using the concept of Object Orientation. These aspects could be exercised in the construction of each business model for the students. Within this context, the use of the game demonstrated, step by step, how to draw the class diagram, and relate the concepts of Object Orientation in building a system. The results of this paper also showed that the use of games allows a greater understanding and a greater belief by students. It enables a formal statement of the teaching process background.

The results obtained by student questionnaires, we noticed there was a significant gain in learning Object Orientation, which leads us to believe the *Gaia ABstraction Game* can be an important tool in the teaching-learning Orientation Object. Unquestionably though, there is a need to apply the game to more students, and students at the undergraduate level, aiming a more consistent and comprehensive result. However, it was possible to evaluate an initial productivity in the learning process with the use of the question instrument.

It is expected to develop either a mechanism to facilitate the object modeled classes implementation during the game, into executable code in programming disciplines, or even objects modeled to contribute in an integrated way among various disciplines

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