# Magic Plane in Homework of Illusion

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Figure 1: Magic Plane Title Screen

**ABSTRACT**

Usually, when talking about games in education, subjects like gamification, game based learning or serious games come to life. Serious games are based on actions in order to develop expressions and skills to operate in real life situations, as well as build knowledge about sundry topics. Whereas gamification, by definition, is the use of game elements in a context not directly associated to games, searching for engagement of the participants. This paper addresses an educational game called Magic Plane whose development methodology followed a backward path way of a traditional gamification model. The archetype design was developed as a regular action game fashion, but after its first prototype it changes into a game to fit educational purposes incorporating some important pedagogical aspects. The project team responsible includes computing technical courses teachers and students, in addition to educators of languages, mathematics, chemistry and geography knowledge areas, subject-matters of the game. The main purpose of the final game is to serve as a playful way to call students attention to some school´s subjects apart from serving as a learning complement.

**Keywords:** games, education, backwards gamification, learning object.

## 1 INTRODUCTION

Game based learning and Gamification has arisen in recent years as a way to innovate and change the way society deals with diverse activities in several areas other than games. Concerning the educational area there are interesting experiences in the connection between gamification and education. The gamification, here understood as appropriation of the mechanics, aesthetics and thoughts of games [9] in some activity, can act as a catalyst for learning environment, providing to the teacher conditions to promote activities based on interaction and creation, stimulate student's motivation and creativity. These conditions allow students involvement through challenging situations, collaborative practices, autonomy and cooperation. It can even change promote behavioral change of the student, who can change from actor to creator in standard school roles.

Digital games are gaining more space in the international market and consequently drawing educational institutions attention [4]. In addition, authors like Mattar [12] claims that attributes of games can be useful in education; game objectives and goals can motivate learners. Educational games are an interactive alternative to the learning process, and may bring a brand new perspective to the context.

There is another aspect present in games (not just on digital games, of course, but that is the focus here): active learning. In a game the player is the active protagonist, just like students and their learning needs are at the center of active learning. According to Jan McWillians ([14]) Artist and Design Director of Art institute of Los Angeles, California in Active Learning students tend to absorb better knowledge coming from a dynamic learning experience. In a game environment they receive immediate feedback about their performance solving a problem or task. It is without doubt an environment intrinsically propitious to Active Learning. However, one of the major challenges associated with the educational game is pointed out by Albuquerque [1]. This author states that not all educational games can relate the educational content with the game operation. In the conception of educational games, one of the known design techniques is develop digital versions for traditional games, looking for keeping the pedagogical aspects of the original versions [6]. Yet, this approach is just a digitization of an educational resource, and may not appeal as a traditional game designed to make use of the technology since its outline. Moreover, the goals, immersion, usability and discovery motivation provided by a real time designed game versus a digitized task is not the same. Even when an educational game is created as an original idea on traditional game development process, to analyze its effectiveness is a complex question, since the game must be educative and comply with educational guidelines, but at the same time should not be boring, keeping and respecting the reasons why people do play games.

### 1.1 Related Work

Naturally, in literature there are some studies about this problem, and it is an old concern. Malone [10] points out that most of the studies address the problem to be the lack of characteristics that make it fun, and forget about what makes it educational. In a recent approach, Barbosa et al [11] after examining a variety of heuristics,

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realized that none of them incorporated all requirements of an educational game. He proposes a new heuristic called HEEG (Heuristic Evaluation for Educational Games), based on others heuristics like HEP (Heuristic Evaluation for Playability) [8], PLAY (Principles of Game Playability) [5] and GameFlow heuristics [18] incorporating ideas from Nicola Whitton previous thesis [19].

This paper reports a different approach, where the gamer students are challenged to create an innovative game focusing on their experience in gameplay and fun. In the stage where its archetype is ready, the game is adapted to fit some educational purpose, without loosing its essence. Here, the presented game borrow concepts from Flappy Bird [17], Geometry Dash [15] and Super Hexagon [3] games, mixing these concepts to create our game. Later, with the aid of professors, the game was adapted to serve as complement to some subjects as geography, mathematics, chemistry and languages. Somehow, the idea can be thought as a different game based learning approach.

The sections are organized as follows: section 2 describes the development methodology as well the game concept and implementation details. In section 3 there is a discussion about the observed results, and finally, on section 4, there are thoughts about the project conclusion and ideas for future works.

## 2 METHODOLOGY

### 2.1 Project Concept

Magic Plane project arose as a learning object and a complementary activity for a group of technical computing high school students and is an initiative of the research group NIJOD (interdisciplinary research center for digital games) from IFMS - Instituto Federal de Educação, Ciência e Tecnologia de Mato Grosso do Sul. The first objective was engage students to use computing concepts to develop games, based on the fact that game creation is indeed a sort of motivation.

The game project followed a similar, but not so rigid, game software engineering approach. Although it is needed more than programmers and illustrators to create a successful game, in theory or certain conditions it can be done [14], specially when talking about simple non-commercial purposes. Projectś managers represent by computing teachers assumed the rule of producers, chief, design and creation directors. Students assumed the rules of interface, levels and art designers as well as illustrators, conceptual artists and modelers. The students, with the support of technical teachers were also responsible for programming, animation, some design tasks and general tests.

Based on traditional game development cycles as concept, preproduction, production, prototype, production, alpha, beta, gold and finally post-production, the development (figure 2 ) was defined as follows:

1. The original game idea, without considering educational elements proceeded through concept, pre-production, production stages.

2. The educational modifications and changes are proposed considering the prototype.

3. After the approval of the educational modifications, the step 1 is repeated, but only for affected features

4. Finally the production stage is finalized, passing to alpha, beta, gold and post-production stages

Compared to traditional educational game, the approach proposed in this work was a little bit unusual: firstly, a game concept is design by the students without focusing on flow, gameplay, among others important game features. When the game project was factual, the team - teachers, educators and involved students - brought

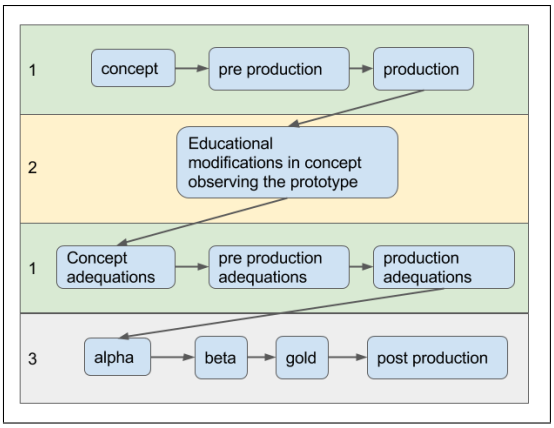


Figure 2: Adopted development methodology

up a list of the design points that could be changed to fit some desired educational concept. The analytical features proposed were:

- Game theme - the team should evaluate if the theme can be changed into a educational one without changing the essence of the game. Notwithstanding, this topic generally is not changed

- Player Pawn, enemies and items - the involved teachers find out that these features are the main point of change. The player character, enemies and items can be shaped to match concepts, relation between words, symbols and pictures or even graphically represent textual information

- story-line - The story of the game can include historical or technical information from desired subject. The obstacle here is modify this information without changing the story integrity

The main concept of magic plane game is a combination of concepts based on Flappy Bird [17], Geometry Dash [15] and Super Hexagon [3] games. This educational version offers several concept association challenges from chemistry, geography, English and mathematics high school subjects. The purpose is encourage the players - in this case, the students - to root the content of these subjects with the aid of a playful activity.

In the game, the player plays the role of the pilot of a paper plane flying around a fictional city scenario. But it is not a regular city, it is a dream world of illusions and the plane must overcome the challenges to survive and escape that reality. On official story-line, the world of illusions is a dream of the student about his homework in which he can only wake up if surpass the obstacles. The plane is controlled by keyboard directional arrows, left and right to simulate plane pitch movement. The speed of the plane is automatic, this happens to pipeline the majority of the cognitive efforts to the challenges instead of complex controls.

There are currently four levels: chemistry, geography, English language and mathematics levels. These subjects were defined by the team in conference with high school graduation teachers. The teachers came up with some of the main difficulties of the students in their teaching subjects. Moreover, the teachers analyzed the original game mechanics and suggested how information could be organized.

On chemistry level (figure 3), the subject theme is organic chemistry focused in the area of nitrogenous and oxygenated functions. The paper plane keeps flying and on the top of the screen appears an chemical formula, which can change. During flight, several obstacles in the format of pictures appears; the plane can (and should)

collide only with pictures that represent a common real life element that make use of the chemical formula on top of the screen 3. Thus, reinforcing element utility, it is expected that students develop a sense of association of the practical usefulness of each compound of the game.

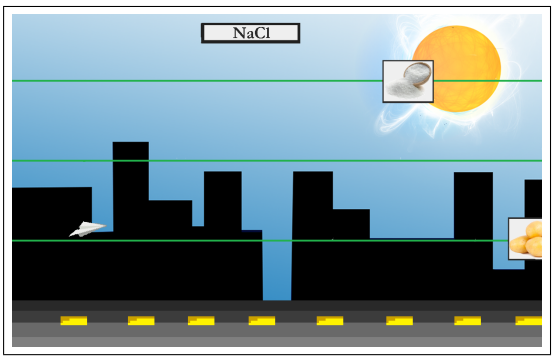


Figure 3: Magic Plane organic chemistry level

Another level is about geography, more specifically about the main types of vegetation existing in Brazil, ranging from the scrublands of the Caatinga, the extensive grasslands of the Cerrado, the Atlantic Forest, and the seemingly infinite wetlands of the Pantanal and Pampa [13]. This level uses the same mechanics as the chemistry level, but the word on top of the screen is the name of a Brazilian vegetation type and the pictures are photos or drawings with clear characteristics of each vegetation 4. The main teacher´s complaint that helped to include this theme in the game was the difficult of the student experienced when trying to relate pictures of a vegetation with its name in regular classes.

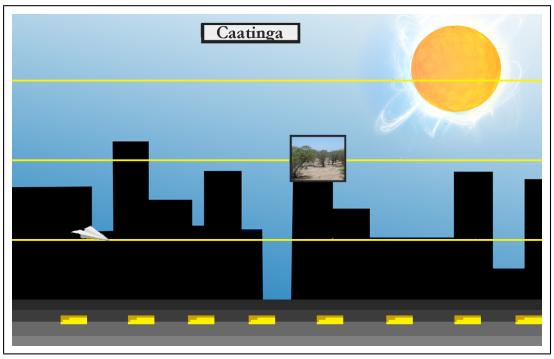


Figure 4: Magic Plane geography vegetation level

The third level was designed around English language. It focus on direct learning of English language throughout cognition strategy. According to Araújo [2], this strategy has at its core the manipulation or transformation of the English language terms by the student, generally the most used ones. So, instead of continuously repeat words and their meanings, the game allows the students to make a direct association with its representative picture (figure 5).

At last, the forth level is about mathematics and basic operation numeric expressions (figure 6). Mathematical expressions are commonly used in everyday life, chemistry, physics, statistics, economy among other subjects. The level challenge is to complete a mathematical expression on top of the screen making it become true. The available challenges of the game includes addition, multiplication, subtraction, division operations in numeric expressions.

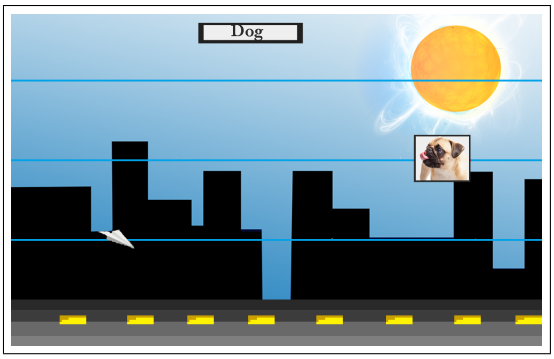


Figure 5: Magic Plane english level

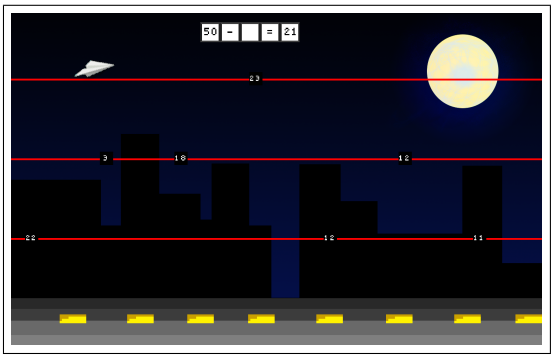


Figure 6: Magic Plan mathematics level

### 2.2 Implementation Details

After conceptualizing the game, one of the decisions to be made was choose which tools were going to help developers the most. After trying out several game engines, the programmers - represented here by the students of the technical computing classes - chose the Construct 2 game engine [16].

The engine fitted all the non functional requisites needs: it is powerful enough for the intended game, uses HTML5 for 2D games, no codding required. The no codding feature was interesting because students that are still learning a programming language but already understand programming logic, can participate directly in the game implementation. Also, The engine is not too complex to use and count with an average developer´s community. Graphics were designed by the authors as part of the activities and the ease of use of the engine allowed the team to show the prototypes to the project coordinators (teachers) at each development cycle.

## 3 Discussion

The main objective of the Magic Plane game is support teachers of the geography, mathematics, chemistry and languages subjects to address some of the issues found during studentś trials. But in no hypothesis it is intended to replace teacherś main methodology. Although there are other learning objects alternatives, the gamification is known to have good results because of a digital game characteristics; as stated by Greenfield [7], a digital game player makes notable progress, as he earns points and accomplish level goals. However, while the game does not end, there is always another level to master. The new challenging conditions added to the feeling of control through gameplay provides a lasting attraction to the task.

As said in section 2, game codification is ready, but the production stage did not begin yet. Even if each responsible teacher has already approved the ideas, the game must be tested in a real class room for some time. A small group of students and teachers tried

out the game, but it needs to be applied for at least one semester in order to compare the real effects of the initiative in students performance in a empirical way. In fact, after each semester of use, it is expected the teachers to indicate improvements based on their observations.

Furthermore, in this work part of the team was composed by students from a computing technical course. So, the development process also acts as a complementary activity directly related to their course subjects like algorithm, programming, software engineering, and so on. This fact also contributes to motivate the students: initially five students were participating of the project; with disclosure between themselves in the class, the number of participants grew up to ten.

## 4 Conclusion and Future Works

Without a doubt, game development is a well received and effective action on a computing technical course. Obviously, in the future the project can applied to others courses as well to see if game development impacts other areas as well. Although a more concrete result of the impact and motivation of the education strategy allowed by the game should come during the next semesters, the mechanics of the learning object is based on pedagogical theories and teachers expertise, shaping the game into one of the educational tools available in the school where it was created.

As future works, it is expected to model an API (application programming interface) in order to allow programs or websites to implement forms to support any teachers to configure the game content at their will. For example, nowadays the challenges available for Magic Plane were proposed by teachers in the development cycle, but it is possible to implement an entry point or tool that allows any teacher to define which words, numbers or pictures should be used in the game, according to his perception of the school class needs.

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