

Building an Intelligent Pedagogical Agent with Competition Mechanism to Improve the Effectiveness of an Educational Game

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Abstract

Different kinds of pedagogical agents to interfere student's learning during the gaming procedure are proposed to improve the effectiveness of educational games in tutoring learning. However, to assess human being's emotions is a tough task and excessive input on the assessment of student's emotions during the game will degrade the level of engagement, thus degrading students' motivation. In this paper, we propose intelligent pedagogical agent with competition mechanism based on Bartle Player Model. The study results show clear increase in the effectiveness of educational games with our approach.

Key Words: Intelligent Agents, Bartle Player Model, Educational Games

1 Introduction

Electronic games nowadays are hot in educational field because they are popular among students. Researchers have been investigating whether and how electronic games can be used to assist learning [1]. Although electronic games are not regular tutoring environments because of their special traits and entertaining goals, we believe that they can be leveraged to help student's learning, if well designed.

Some pedagogical agents have already been designed to improve student learning during game playing. Some studies aimed at making pedagogical agents that can both simultaneously stimulate learning and maintain the high level of engagement, as educational games usually generate [2], and our approach just follows this way.

In our educational game, *As Fluent As Possible*, we have a multi-user environment. It is more complicated and difficult to balance the learning and entertaining within a multi-user game than a single-user game. Bartle's Player Model [3] is a well known model which helps describe player's types within a MUD (Multi-User Dungeons). We leverage Bartle Player Model to design a competition mechanism for our game so as to incorporate with the existing intelligent pedagogical agent in tutoring learning.

2 The Game and Existing Pedagogical Agent

Empirical survey shows that a large percentage of Chinese students can hardly take basic English communications with others after their graduation from colleges. One

reason is that current English learning approach excessively emphasizes on reading and writing. As Fluent As Possible provides a chance for students to develop their spoken English.

However, at the beginning, student can only practice single sentences, get scores and obtain the agent—Rocky’s unsolicited suggestions according to the comparison result between his speech samples and the benchmark operated by the engine.

This educational game has several drawbacks. First, student may feel tedious after the first exciting period. Second, a new comer can hardly get enough credits to surpass another student whose ability are at the same level but have got several more hours practice time. Last but not the least, information within the suggestions from the agent seems only useful to those students whose purpose of playing the game is to improve their English speaking skills.

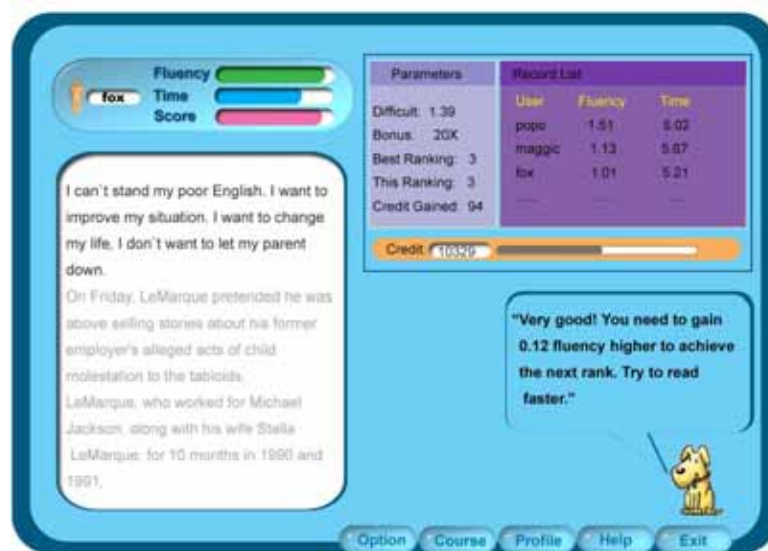


Figure 1: As Fluent As Possible

3 Competition Mechanism

3.1 Killers vs. Achievers

To overcome the above disadvantages, we find that the biggest challenge is how to guarantee the student’s level of engagement. First of all, we need to maintain a balanced relationship between the different types of players in this multi-player educational game.

According to Bartle Player Model, there are four types of players within a multi-player game. While in our study, we concentrate mainly on two of them: Killers and Achievers. Figure 2 clearly illustrates the relationship between them.

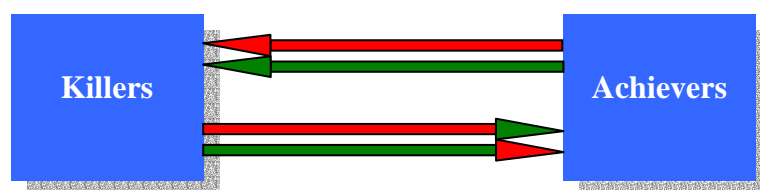


Figure 2: Killers and Achievers

In Figure 2, green color indicates increasing numbers while red color indicates

decreasing numbers. A red line with a green arrowhead means that decreasing numbers of the box pointed from lead to increasing numbers of the box pointed to; a red line with a red arrowhead would mean that a decrease in one leads to a decrease in the other, and so on.

Increasing Achievers We use two approaches to achieve that:

a. *Raise the rewards for achievement.* We import the concept of Bonus, which stands for extra credits to student who breaks the records. The formula is:

$$Bonus = 10 \times C \times \lfloor n/3 \rfloor \times k \quad (*)$$

where C represents Credits which the learner gets at a time;

n represents Record break times;

and k is a variable defined by record rank, when record rank = 1, 2, 3, $k = 2, 1.5, 1$.

b. *Set an extensive level system.* We propose a formula for level calculation:

$$Credit = 10 \times (L^3 + 4 \times L) \quad (**)$$

where L represents each level;

Following this non-linear formula, it will be harder and harder for students to reach the next level. However, that's what Achievers prefer. By operating these two approaches, the interests of Achievers can be greatly enhanced.

Maintaining Killers Although decreasing the number of Killers can increase the number of Achievers, keeping a certain amount of Killers is necessary for balance. We provide Killers opportunities to demonstrate their abilities. Each sentence in the course has a record which maintains the top three students in this sentence. Every time a student breaks the top three records he will be given a considerable bonus according to (*). At the top right corner we can find the record list.

Here *Fluency* is the metric of student's performance whose formula is:

$$Fluency = \frac{Score}{Time} \times \frac{TimeofBenchmark}{ScoreofBenchmark} \quad (***)$$

Since Killers always try to seize all the records and kick other students out of the top list, it is easy for some students who do not have much potential to compete with Killers to give up and leave. In order to avoid this situation, we endow different level records with different refreshing frequency so that Killers in a higher level are not able to disturb the order in lower levels, thus protecting new comers.

3.2 Refined Pedagogical Agent

After adding the competition mechanism into the game, Rocky can provide some more suggestions on the rank relationship between the student and others thus enhancing the interactions among them. Table 1 demonstrates possible suggestions from Rocky:

S-1	You need to improve.
S-2	Your speech is good. Try to read the word “ <i>someword</i> ” louder/less louder/higher/lower/longer/shorter (and louder/less louder/higher/lower/longer/shorter).
S-3	Your speech is excellent!
S-4	Very good. You need to gain “ <i>somenumber</i> ” fluency higher to achieve the next rank. Try

	to read faster (and/or pronounce better).
S-5	Excellent! You've got the best rank of this sentence!

Table 1: Sample Agent's Suggestions

The S-4 and S-5 are added in the current version. Take two types of students in the game into account; they will both get benefits from those suggestions. For example, speaking of S-4, Killers can get to know the gap between him and the one in front of him; while Achievers will be glad to know which he would pay more attention to improve, the pronunciation, the time, or both, in order to get a high rank.

4 Study and Evaluation

Our user study involves ten college students in the game for a period of three weeks practice. Before the study began, we did an interview in order to assess the student's English skill levels. The result showed that two out of ten students were evaluated to be *Reasonable*; others were all evaluated to be *Not So Good*. Then we divided them into two groups whom were given different versions of *As Fluent As Possible*: group A was given the former version and group B the new version.

Evidence showed that although both two groups gradually practiced less during three weeks, students in group B practiced more sentences and gained more credits than students in group A, mainly due to the competition mechanism. At the end of the third week, we collected their data and drew some diagrams, see Figure 3.

Then we ran a post-questionnaire with all students. Students in group A seemed to be the same in the self and mutual evaluation with one exception; while four out of five students in group B were evaluated to improve. In the comments they acknowledged that the game, especially the competition mechanism successfully kept their motivations and enhanced their self confidence, so that we can guarantee that the effectiveness of the educational game is improved by the modification.

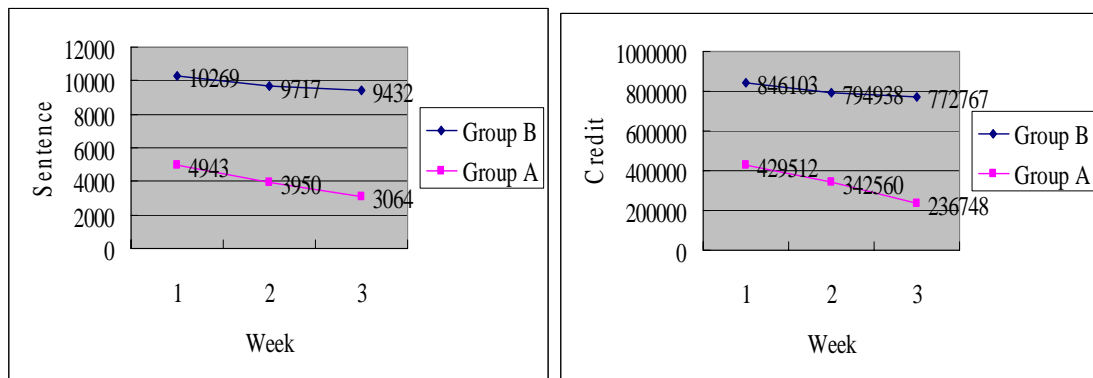


Figure 3: Study Statistics

5 Reference

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