

EDUCATION IN A COMPETITIVE AND GLOBALIZING WORLD

**EDUCATIONAL GAMES: DESIGN,  
LEARNING AND APPLICATIONS**

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AND  
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Chapter 15

## INTERACTIVE FICTION AS EDUCATIONAL GAMING FOR L2 ENGLISH IMPROVEMENT

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### Abstract

This chapter presents an application of Interactive Fiction (IF) as a main tool for L2 English young learners in a 'learning-by-doing' approach, based on a pilot experiment. IF is rooted in the history of Computer Science and Artificial Intelligence as a main tool of playing through computers when they had little graphics, if any, as playing is performed as a text-based man-machine dialogue. Most IF novels were written in the 1970s and 1980s and were adventures, often settled in a sci-fi or fantasy world — the most notable being *Zork* and *Amnesia*. After the development of computer graphics, IF became a *divertissement* for aficionados, who formed a lively on-line community thanks to the Internet, releasing for free — often in open source — old and new narratives. Some ad hoc programming languages were designed for IF writing, such as *Inform*, *Hugo* or *TADS*, but they still required previous programming skills being object-oriented. This situation changed in 2006, when Graham Nelson released *Inform 7*. Unlike the previous versions, *Inform 7* does not require any particular programming skill, as commands are written directly in English, preferring a declarative rule-based style of programming over object-orientation: the result is a highly human-readable source code. Now, there is a consistent set of narratives written in *Inform 7* available for free, as well as an advanced IDE in different operating systems, so that *Inform 7* can be easily used in the classroom. After playing some existing adventures, in order to learn how to deal with a sophisticated natural language parser (and its limits), students are grouped together in order to write their own IF stories to be played by the other teams. The paper shows some educational strategies in using *Inform 7* in the classroom with the following goals: to improve L2 English proficiency; to acquire the basics of natural language processing; to expand creative writing skills, dealing, for instance, with multiple endings; finally, to teach the fundamentals of computer programming.

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## 1. Introduction

In Italy, pupils are often exposed to L2 English in primary schools or even kindergartens. Nonetheless, evidence has shown that their L2 English proficiency, even after 5 years of studying at school, is less than satisfying in most cases. The teaching approach and the educational setting in the classroom is one of the variables that can be controlled in order to achieve better results in learning. My claim is that the 'tell-and-test' method followed by most L2 English teachers — e.g., through filling holes in fixed phrases, or through multiple choice questions — has severe limitations. In fact, if the act of learning can be described as an act of *search for meaning*, the 'tell-and-test' forgets to consider a main aspect in learning: the fact that the learner does not learn anything about the *process* of learning, and analogously the teacher wants to learn from the learners about their process of learning — these are the principles of metalearning and feedback, as stated by Bateson [1972].

In contrast, constructivist approaches in learning give emphasis to the role of the learner as a unique individual from one side and the role of active collaboration among learners from the other side. In this perspective, the result of learning is the finding (or building) of a mental model with its own rules of regulating knowledge chunks, called *learning unity*. Each learning unit is formed both by a learning process, i.e., the act of learning in itself, and a metalearning process, i.e., the act of learning how to learn. I argue that the process of learning becomes much more quick and effective if the metalearning process becomes explicit to the teacher as well as to the learners. In Vygotsky's terms, the goal is to put the Zone of Proximal Development (ZPD) to zero as quicker as possible [Vygotsky, 1986]. The ZPD is the difference between what the learner is able to do without help and what is able to do with the help of the teacher or peers. Consequentially, learning should be measured in different settings, i.e., first in groups or in pairs, then without any help.

In this chapter an application of this constructive approach to the known problems of L2 English learning is proposed through the use of Interactive Fiction (IF) in an educational context.

## 2. Interactive Fiction as an Educational Medium

IF is a new form of literacy possible only with computers, from their early age. In fact, IF writing historically is one of the first application of computing for gaming, because it needs little, if any, graphics, as playing is performed as a man-machine dialogue. Most IF adventures were written in the 1970s and in the 1980s, when graphics in computers was not a given feature as it is nowadays; the most successful, e.g., *Zork* or *Amnesia*, were settled in sci-fi or fantasy worlds — for a more detailed account about the history of IF, see Montfort [2003].

In recent years, IF aficionados put interpreters, IF binary and often source code files of classic games into the internet, forming a small but very living community. A more or less official repository of classic and new IF games is the IF Wiki. There is even with an annual competition for new IF stories written within the current year, called 'IF Comp', plus the 'XYZZY Awards', for specific features of the stories.<sup>1</sup> Therefore, there is a quite large

<sup>1</sup>The IF Wiki is available at <http://ifwiki.org>, while the official web site of the IF com is <http://>

number of stories freely available, that can be played in the classroom. A side advantage of such a technology is that interpreters are free software that also runs on personal computers with old operating systems, e.g., Windows 98, and in any case there is a very good support for any major system, i.e., Windows, Mac OS X and Linux. In fact, as far as the author knows, personal computers in Italian classrooms are often quite old and school heads are not willing to invest money in buying software licences: these problems does not arise in the case of IF.

The first step for learning IF is playing a couple of games which are ready off-the-shelves. As argued by van Eck [2006], there is a risk in edutainment software, i.e., that "academization" will cause the loss of fun by the learners-players because they are perfect for learning but boring to play. My claim is that learners delving into IF gaming through a 'learning-by-doing' approach – including teacher's help – will avoid this risk.

It is important that the first learning unit to be presented in the classroom pertains the user interface experience, which is quite different from modern graphical games. In fact, the traditional concept of 'plot' of noveling is completely revised in IF, as the IF writer decides how the story begins but typically there are more endings. Unlike traditional novels, the writer should foresee the possible actions taken by the reader's avatar, i.e., the character which is commanded by orders written in natural language through the command line. Commands are given in a subset of English, i.e., a domain-specific subset of English for special purposes, where for instance you can 'tell [someone] about [something]', 'open [something] with the [instrument]', 'go to [a room]' or 'give [something] to [someone]'. The exact language depends on the parser, and the most frequent command can be abbreviated. In an old experiment of IF in the classroom taken by Lancy and Hayes [1988], "[one of] the greatest source[s] of frustration for our students surrounds the difficulty in making the right choice of words to 'get the computer to do something' (p. 44, quotes in the original)". Note that in our context learners know English as a L2. Therefore, it is even more important that the teacher of English should also be familiar with IF game conventions, so that he or she can lead young learners in playing the games, avoiding the frustration underlined by Lancy and Hayes [1988].

Already in that phase, young learners become familiar with a lot of common English verbs in their practical use, e.g., they learn to distinguish when the arguments are animated or not and in what order they should be put in sentences. Let me explain through an example: 'ask [someone] about [something]' is a word order that which should be learned apartly by Italian natives, because in Italian the order of the arguments is exactly the opposite, i.e., *chiedi qualcosa a qualcuno* (literally, "ask [something] to [someone]"). In such cases, the parser acts as an impartial referee of the quality of the work written by learners, as the teacher is not judging the work on subjective criteria. In Vygotsky's terms, the ZPD is reduced by the fact that there is a validity check of the pseudo-English source code, as learners perform their learning units without any external aid. This is particularly true in case of errors. Errors are learning units, where the learning aspect is understanding *what* went wrong, i.e., which piece of code does not fit, while the metalearning aspect is understanding *why* the error arose, i.e., which rule was violated in terms of parsing – here the role

of the teacher is crucial, as well as the user interface feedback.

But the most exciting phase is to let learners write their own IF stories, which is the second phase of their L2 English improvement. To obtain this result, I argue that a particular ad hoc programming language for IF writing should be used, called Inform 7. Most IF games have been written in ad hoc programming languages, where some layers of abstractions are already implemented in the language, such as the avatar, the rooms, movements and basic commands. Since the 1990s, the most used ad hoc programming languages used to write IF stories are Hugo, TADS and Inform. Until 2006, they all had a C-like syntax with some form of object-orientation – see MacLennan [1999] for a comparison between different principles of programming. In practice this means that, in order to write a game, the writer should also be competent in the fundamentals of object-orienting programming, which is a high request for the classroom, both for young learners and the teacher. This fact arguably has limited the production of new IF stories. For this reason, following the hypothesis that “the natural language in which to write interactive fiction is natural language” Nelson [2006] released the 7<sup>th</sup> version of the Inform language, which is completely new, compared to the previous ones. As computer programming is a particular way of writing, because it is human-readable and computer-executable at the same time, a good programming languages should take into account both aspects – Nelson [2006] in fact was explicitly inspired by Donald Knuth’s “literate programming”. IF playing is perceived as a continuous dialogue between the player and the computer where the goal is to reach a state in which both are content, i.e., the player succeed to make the avatar do what he or she has in mind. Hence, a particular attention is given to human-understandability of error messages. In sum, Inform 7 is built over a 30-years experience of IF writing under a very particular approach, which involves the well-known problem of the codification of natural language semantics. Also thanks to the advanced IDE, which provides a map of the possible actions that a player-reader can take in a given moment, Inform 7 very quickly became one of the most used programming languages for IF games. Finally, there are some IF narratives written in Inform 7 available in open source, so that a newcomer can study and understand how to write this kind of code, which is a subset of English.

### 3. The Pilot Experiment

In order to understand how Inform 7 is feasible for the classroom, a pilot experiment was conducted with the author as the teacher and Sebastiano Gobbo – one of author’s brothers – as the learner (13 years, at the time of the experiment, December 2006).<sup>2</sup> The experimental setting was settled as follows. A single computer for teacher and learner was provided, and the keyboard was switched from the teacher to the player every 25 minutes, plus 5 minutes break. The person actually using the keyboard is called ‘driver’, while the other member is called ‘navigator’. This setting is known under the name of *pair programming*, a key technique of Kent Beck’s eXtreme Programming (XP) software development paradigm [Beck,

<sup>2</sup>It is worth noticing that, at the time of writing (17 July 2009) there is no known use of Inform 7 specifically for L2 English classrooms, according to Emily Short’s list published in the official web site, <http://inform7.com>. By now, there is an e-learning experience conducted in Germany through a German version of Inform 7 (see Donick [2009] in Harbach et al. [2009]), while all other educational experiences involve L1 English learners, most often for empowering their literacy – see for instance Kozdras et al. [2006].

1999]. Moreover, the 25+5 minutes are called a *pomodoro* (Italian word for 'tomato'), a time-boxing unit of focused work, as defined in the Pomodoro Technique – see Gobbo and Vaccari [2008] in Abrahamsson et al. [2008] for an account. The first part of the experiment was conducted in 3 hours of pair programming during a Saturday afternoon, in which 5 pomodoros were consumed in total (sometimes breaks are longer than 5 minutes).

The first two pomodoros were spent in IF playing: in the first pomodoro the teacher was the driver, and he asked the learner questions about what to do, while in the second pomodoro the question were still asked by the learner, even if he was the driver. The game chosen by the teacher for the first play was *Floatpoint* by Emily Short, the winner of IF Comp 2006, which also obtained the Best Setting and Best NPCs XYZZY Awards 2006 (NPC stands for 'Non-Player Character'). Emily Short is one of the most active and well know IF writer, and this story has a novice mode as well as a gradual hint system, a very helpful feature for beginners. Furthermore, it has a good number of rooms, so players learn how to represent mentally a map described only by words written in a L2 language. A couple of tricks were successfully solved – with the help of hints. It is worth mentioning that the teacher had already played this game and he had told this fact in advance to the learner, who had the feeling to be safe, drastically reducing anxiety. Moreover, there is no cruelty in the narrative, i.e., the avatar does not risk to die or be injured, or to injure any NPC.

After the second break, the teacher proposed to remove the curtain and write their own IF story. The learner was a bit reluctant, but he was convinced by awareness: each IF story can be published officially, i.e., it can be marked by a unique identity number called IFID – a sort of ISBN for IF stories. The perspective to leave a trace in the internet with his very own name as an author was received enthusiastically, so that the third pomodoro could start. The scenario was completely decided by the learner, who expressed the desire that the IF writing process should terminate in that afternoon. Therefore, only a short story could be written.

Figure 1 shows the final code of the first release of *Monza's Phantom* in the Inform 7 IDE (Windows version). The IDE resembles a book: on the left page there is the source code, on the right one the code is playable for testing – if no syntax errors are found. The full writing of this very short story – only three rooms, three sceneries, one object – was done in two pomodoros. In the first pomodoro the teacher was the driver, as he had some previous knowledge about the syntax of Inform 7. In any case, the description – i.e., the text in light blue put between quotes in Figure 1, which is actually read by players – were completely chosen by the learner, who had decided the scenario. Conversely, the short plot and the source code (black coloured in Figure 1) was written by both. Sometimes syntax errors occurred, mainly due to anaphora resolution failures: in a couple of times the solution was proposed by the learner. After two pomodoros the code was ready, i.e., without any syntax error. In the last pomodoro, Romualdo Gobbo, the developers' father, played the game as a tester and he succeeded to complete the game in approximately 5 minutes.

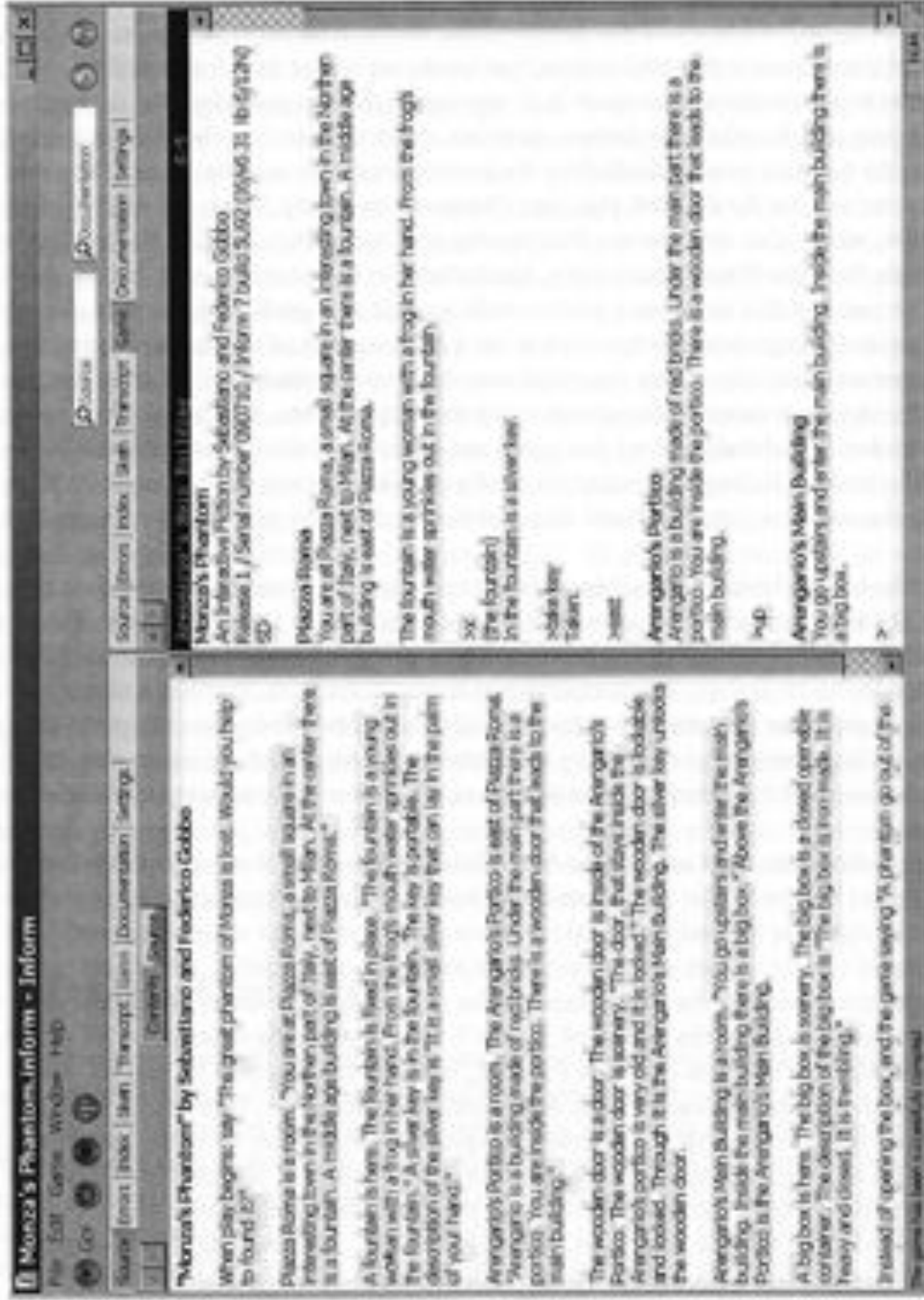


Figure 1. The source code and the bug in the first version of *Monza's Phantom*.



The rest of the pomodoro was spent by the teacher in uploading the source code, filling the form with basic information.<sup>3</sup> The teacher asked the learner if peers, e.g., classroom mates, could play it within the next week, as the next Saturday they would have the possibility to meet again.

As seen, very short time was spent in testing, i.e., playing, before delivering the game into the IF Wiki repository. By no means this is a good practice: it is interesting to note that the game was played by a couple of Sebastiano's friends within the week but no one noted the bug (Figure 1, right), probably because they never played an IF game before. Anyway, one of them said that 'a good game should have points', a feature that neither the teacher nor the learner were thinking about while writing. On the contrary, some people in the community suddenly noted the bug, classified as an 'elided puzzle bug' and they put a note into the wiki page dedicated to *Monza's Phantom*.<sup>4</sup> The reasons behind the bug are quite clear. As shown in Figure 1 (right), the door can be passed through without unlocking, "flying" directly into the Arengario's Main Building. The problem is in the word 'through' in the source code, which does not refer to a precise room: the door can be unlocked, but it brings nowhere.

After a week the teacher and the learner met again, and the teacher explained the bug, which can be considered a kind of errors. Under a constructive point of view, errors often are good signals for further improvement: the learner was stuck by the fact that the compiler did not point out the error, so the teacher explained the difference between syntax and semantics, a crucial concept in language understanding, both considering natural or programming languages. This learning unit is very important, as the activity of IF writing not only improves the competence in L2 English, but it also teaches some fundamentals of computer programming.

A couple of pomodori were spent to write the second and last version of the game, where the bug was solved and a basic system of point rewarding was added – according to the desiderata expressed by the learner's classroom mate. Figure 2 shows an optimal play with point rewarding, and the bug fixed.

It is interesting to delve into the solution found for the bug. In fact, the teacher let the learner propose how to refactor the code, i.e., how to rewrite part of the narrative. The final solution was found by the learner, i.e., adding a new room, called Arengario's Stairs. This solution is not so trivial as it can appear at a first glance to experienced people. In fact, IF writers using Inform 7 should learn that also stairs can be a room, 'room' being one an abstraction used by the parser to build the game world space. Nelson [2006] clarifies that the number of such abstractions, or "built-in kinds", was kept to a minimum, compared to other programming languages suited for IF such as TADS, so that the initial learning curve of Inform 7 is very low.

<sup>3</sup>See [http://www.ifwiki.org/index.php/Monza's\\_Phantom](http://www.ifwiki.org/index.php/Monza's_Phantom), which is the permanent link in the IF Wiki repository, with its unique IPID.

<sup>4</sup>See [http://ifwiki.org/index.php/Elided\\_puzzle\\_bug](http://ifwiki.org/index.php/Elided_puzzle_bug) for a description of this kind of bugs, which is typical of novice IF writers.

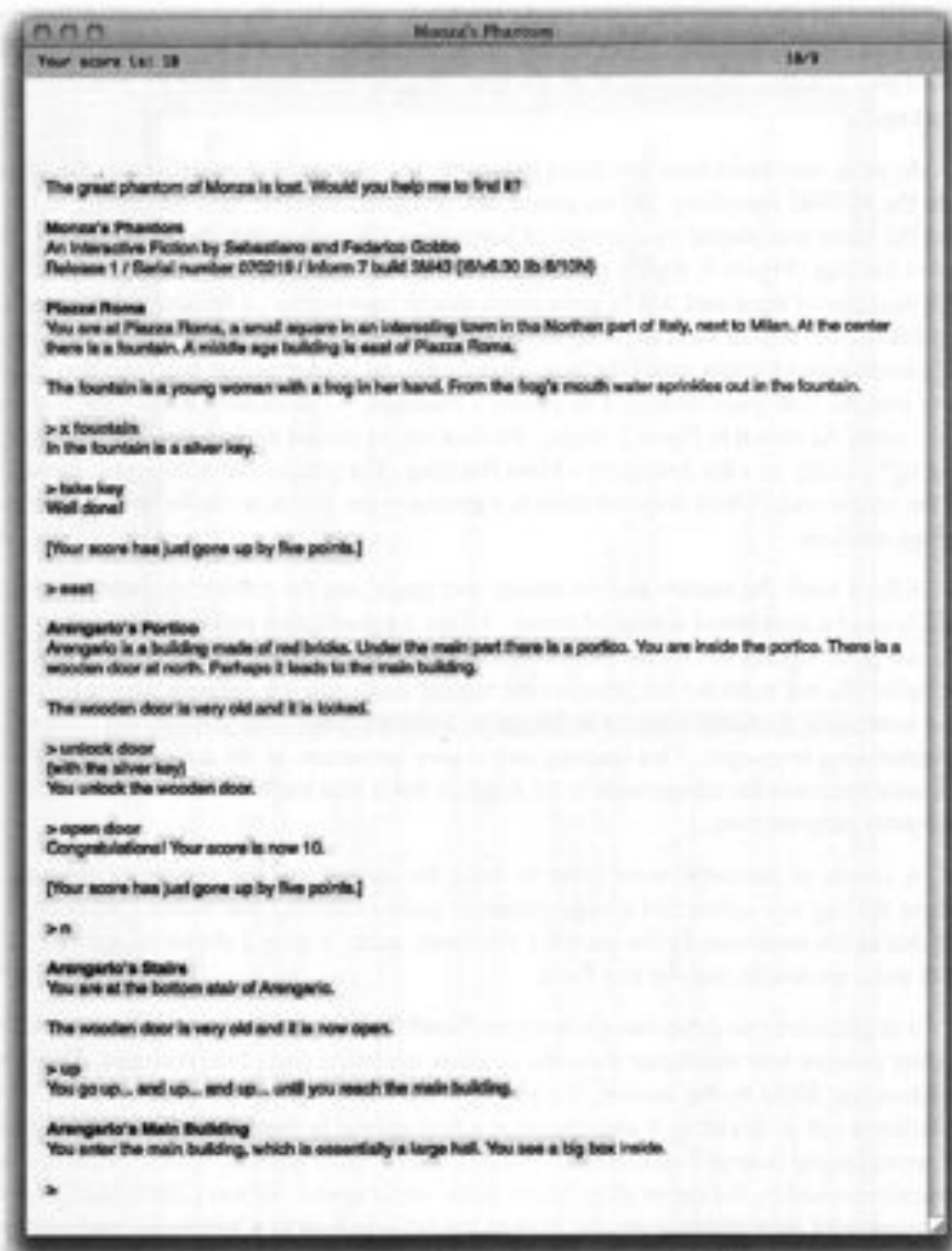


Figure 2. The playing of *Monza's Phantom* (final version).

## 4. Discussion

The activity of writing an IF narrative involves a lot of different competences, and an educational setting puts on the table some additional problems. Here, I want to discuss possible extensions of the pilot experiment in a classroom of L2 English learners (10-15 year old). Luckily, in the handbook recently released by Aikin [2009], which was written having in mind beginners and especially youngsters, there are some advices, based on the author's experience in the classroom. He lists five common problems in starting to write a story with Inform 7: forgetting to say "say", missing period at the end of a sentence, misspelled word; colon instead of semi-colon or vice-versa; wrong indents. Quite interestingly, two of them are typically errors concerning computer programming (wrong indents and forgetting to say "say"), while the others are writing errors which are valid more in general. Under a constructive perspective, Inform 7 seems to teach learners to be very precise in writing, which can be considered a highly valuable result. For sure, another cognitive module activated by IF playing is the art of problem solving: very often a story in a given turnpoint puts the avatar in a blocked position, that can be overcome only through the solving of some problem situation.

It is important to note that the educational setting should be changed in the context of a classroom classroom, in order to follow the path of the pilot experiment. These are the phases individuated in the pilot experiment: first, playing IF games; second, writing an IF story in pair programming; third, testing the story in development; fourth, testing the story in delivery, i.e., make other people play it; finally, code refactoring for bug fixing, and releasing. The first phase can be organised as follows: the teacher brings in the classroom a laptop and a projector, and he plays the game asking for help by the students. This permits to familiarize with the parser in an easy way. A chalk and a blackboard can also be useful to depict the syntax intricacies of Inform 7, in order to avoid the frustration described in Lancy and Hayes [1988].

The second phase is more challenging. A good scenario should be defined in advance, so to avoid non-compatible ideas between learners. A suggestion could be to imagine a quest, which does not need too much knowledge of Inform 7 syntax – in comparison, the management of NPCs is much more difficult. For example, let's imagine that the twelve stars of the EU flags are lost in twelve important museums in member state capitals, e.g., Musei Vaticani in Rome, or Tate Gallery in London. In Inform 7 it is possible to add images to the descriptions: if twelve schools being in different countries across Europe write twelve quests, adding descriptions and images of their museums, the teachers should put the quests together in a given room and afterwards every national team has eleven unknown quests to solve. In this way, learners could not only improve their English, but also increase their knowledge of arts. To retain the pair programming technique within a group, a setting called *randori* – which is a Japanese term, used in martial arts to describe free-style sparring, often with multiple attackers – sometimes used in XP software developers. The *randori* setting adapted for the classroom is as follows. The teacher has a laptop and a projector, with the Inform 7 IDE up and running. Every 5 minutes he or she invites a learner to join the teacher as the driver: in other words, the teacher always remains the navigator, i.e., he never touches the keyboard. If the driver is blocked, it will be changed. Of course, the order of invitation to join is not known in advance by the class members, so hopefully every learner

should keep the attention high, as within 5 minutes he or she can be asked to write along the writing line of someone other. The third phase is made up at the same time, i.e., sometimes 5 minutes are spent to run the game for testing.

If we are in the scenario where more classrooms are participating the project – e.g., the quest of the EU stars – the fourth phase is similar to the first one, save for the fact that the class isn't playing a published IF story but a pre-production part written up by another classroom. The last phase, i.e., putting all together, bug fixing and releasing, could be done by the group of teacher, again through a randori, with the difference that the newcomer becomes the navigator, and the existing navigator becomes the driver, while the past driver goes back in the public.

## 5. Conclusion

Emily Short, when she was a session chair in Hypertext 2007 Conference, noted that IF playing is “not so much an opportunity for the player to invent a character (as seen in role-playing games) but to play a character already designed by the author: to become familiar with that character's quirks and limitations, beliefs, prejudices, and circumstances.” On the other hand, writing an IF story lets the learners build such a character, which could be important in an age where personal identity is quickly changing. As a final note, one of the interpreters for playing IF narratives written in the Inform 7 format, called Frotz, is also available for handheld game consoles such as iPod Touch, Nintendo's Game Boy Advance and Sega Dreamcast: this fact can be used as an additional motivation for engaging young learners in writing IF stories.<sup>5</sup> In conclusion, Inform 7 has proved to fit the need for improving L2 English knowledge under a ‘learning-by-doing’ approach, and additionally it also teaches the fundamentals of computer programming as well. Finally, the IF story scenario can be chosen appropriately, for instance regarding arts.

I wish to acknowledge my brother Sebastiano and my father Romualdo, who agreed to take part in the experiment. I should also thank Annie Mazzocco, for discussing with me possible extensions of the pilot experiment in real classrooms, putting in evidence the goals and the problems. Finally, I also want to acknowledge my friend and colleague Matteo Vaccari, who told me first that the community of IF aficionados was well alive, creating amazing new stuff like Inform 7.

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<sup>5</sup>The home page of Frotz, which is free software, as it is distributed under the GNU General Public License, is here: <http://frotz.sourceforge.net>.

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