Aviation-Oriented Gaming and Second-Language Acquisition

Mark LANDRY¹ and Lenka LANDRYOVA²

¹Language Department, VSB - Technical University Ostrava, 17, Listopadu 15, Ostrava, Czech Republic
²Department of Control Systems and Instrumentation, VSB - Technical University Ostrava, 17, Listopadu 15, Ostrava, Czech Republic

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Abstract. Teachers have a plethora of online materials available to make their lessons more effective. This paper examines the effects of using digital media, in particular aviation-focused gaming, in assisting students in second-language acquisition. It considers the fact that the traditional roles of teachers are being partially transformed, and that many gaming sites preferred in the Czech Republic are in English. Part of the paper’s conclusions derive from observations and recordings made during English language lessons, involving various groups of ten to twenty-five students studying transport engineering at a Czech technical university. These conclusions are derived from the implementation of a game focused mostly on air traffic control simulation, and on observations which look at how students are learning from each other. Also to a lesser degree this paper investigates how airport management and airport maintenance gaming and simulations can help practice and improve student decision-making and enhance cognitive abilities

1. Introduction: the Attraction of Gaming

The chronological course of gaming is linked with the development of the computer and has been similarly evolving as new technologies are enhancing how games basically work. It was only with the introduction in the 1970s of multiplayer games that players were able to communicate and interact with other gamers in different ways. According to 2014’s Essential Facts about the Computer and Video Game Industry, gaming is also becoming more acceptable in households and about 60% of Americans play some sort of video games, and about the same percentage of increasingly involved parents believe that they have a positive role in life and learning [1]. In Scientific American Elena Malykhina has stated that almost 80% of teachers surveyed have found using video games has improved the performances of low-achieving students [2]. Moreover, after examining more than three-hundred articles related to gaming Michael Young and associates have more specifically found that there are effects particularly for language-learning over other subjects such as math and science [3]. So, is it possible that something which can be considered as just mind-numbing entertainment and potentially harmful if misused, can also be learning-oriented, and thus real edutainment? So, what is its attraction and why is it becoming increasingly popular mostly among young people?

Firstly, it can offer a relief from the stress of school and life in general, and according to the findings of Krashen [4] and others a second language is best learnt when anxiety is low. All you need is a net connection which is easily accessible today. Unlike traditional language learning textbooks it comes with great, graphic technologies that allow you to be competitive, co-operative or something in-between depending on your style and interest. Unlike the classroom it offers a variety of participants from across the globe. You can become involved in a participatory activity where you can be creative and can show your talent on social websites to the world, and where you can learn strategy and tactics and gain experience. And correspondingly Thorne [5] has found that if a computer game like World of Warcraft is
expanded to an international exchange it leads to an increased motivation in language learning. If you play the same game repeatedly you can be constantly updated about your progress. And in addition to teaching you technical skills such as basic coding principles, you can exercise your spatial thinking, reasoning powers, memory, perception and problem-solving ability. Like all games, they are usually more fun and enjoyable than the prescribed curriculum in a classroom, and you may be learning something although you don’t realize you are learning. In order to see if this makes the role of a teacher and language-learning textbook more obsolete in this age of increasing competing interests, we have to examine the use of gaming in the classroom, and what is happening during gaming in more detail by asking the students about their own perceptions.

2. The Transitional Role of a Teacher

In effect these new tools of technology and transforming educational environments are affecting how much time students are willing to devote to traditional learning scenarios. What it means is that students can become more selective about what they are learning from the abundance of on-line material available and a teacher doesn’t always have to be central stage. In a classroom, it is possible for a committed teacher to play multifaceted roles which include that of an information provider, organizer, assessor and prompter. For example, Sylvén and Sundaquist [6] studies have found that serious gamers are reading fewer books. Nevertheless, perhaps in reaction to limiting access to gaming in schools, Chik [7] sees that language learning is being passed on to wider extra-curricular communities that have taken on the roles of language teachers, and thus are generally depriving students of some purposeful learning guidance and of being corrected.

Since the time of American educator John Dewey there have been many arguments for both teacher and peer-to-peer learning in regards to keeping things under control, and in having students becoming more independent especially in the own decision-making. The argument is by having students work together it could provide a way to keep students more interested and less anxious in what they are doing.

One can go all the way back to Socrates to question the real role of a teacher. Inevitably, by allowing at least part of a lesson to be devoted to student-oriented gaming-learning activities a teacher consciously forsakes his/her role as mostly an imparter of information and becomes that of more of a facilitator or prompter. And as H. Brown Douglas [8] has found success in language learning largely depends on the rapport teachers establish with their students. In stepping back a better chance can be provided to examine how engaged students are in dealing with the challenges and problems in grasping a foreign language, even if there may not be many opportunities to review the rules of grammar [9].

If implemented with intelligence combining gaming with an emphasis on peer- to- peer learning can be more effective and interesting than focusing only on more traditional forms of teaching and learning. As to methodology, Jeffrey Froyd [10] gives tips on how to gradually switch from a teacher-oriented level at a higher education institution. By taking on the role of an enhancer, a teacher, also becomes a type of participant in the lessons, using questioning strategies while able to correct serious misconceptions in grammar, spelling and pronunciation, empowering students and allowing them to focus more on their own social interactions, creative abilities and on thinking critically.

3. Airport Management Gaming and Decision-Making

So, if students seem to be learning from each other directly or indirectly during gaming, and if there is some desire for more student-oriented learning, allowing a teacher to take on a more secondary role, why not try to partially put it in practice during a weekly lesson? And moreover, developments in gaming and simulation ergonomics have made it more realistic, meaning that it has become more unlikely that similar
looking devices, such as those used to control different parts of an airplane, could be confused even on less expensive gaming consoles.

For about 20 years the Institute of Transport of the VŠB - Technical University of Ostrava has provided instruction focused on specialized English for the subject Air Transport. In helping those interested in such subjects as aviation study, advancing technology has increasingly allowed it to be possible to partially supplement tutorials with visual aids and gaming software. Outside being in a virtual cockpit or control tower one method on how to develop experience in making strategic decisions and decision-making ability in the aviation industry is to use gaming focused on airport management.

Various sources have confirmed its effects. According to the findings of Bruce Bower playing video games can improve decision-making when used alongside other traditional training methods [11]. In Policy Insights in the Behavioural and Brain Sciences they have been shown to reduce susceptibility to bias blind spots while decision-making [12]. Daphne Bavalier and associates have found that the development of perceptual templates has advantaged the decision-making abilities of gamers over non-gamers in action games [13]. In regards to management decision-making it is up to a teacher to select the type, emphasis and difficulty of a number of commercial games available online focused on aviation, which now include Airport CEO/An Airport Tycoon Game, AirlineSim, The Airport Game/Management Game, The Terminal Game - A Realistic Air Simulator and Airport Master: The Ultimate Airport Management Guide.

In practice and as the number of computers allows, students can compete against each other while the teacher goes around and checks their understanding and written responses. In this way the learning of a second-language is somewhat limited, in that it mostly does not really focus on speaking or listening skills. In most of the games students are given a huge amount of data that usually is regulated by time and situation (such as having airplanes leaving every five minutes) The activities mostly involve decision-making on such things as building an airport infrastructure, including runways, taxiways, gates and tarmac or items inside the terminal such as the number of check-ins, security, restaurants and shopping. They can also involve hiring employees and management, making deals/contracts with airline companies, deciding which frequency of traffic could generate the most money, balancing budgets, establishing subordinate departments, investing in the right technology and keeping customers and staff happy despite occasional employee and equipment breakdown, bad weather, costly delays and emergencies.

4. Airport Maintenance Gaming and Cognitive-Analytical Skills

Another possibility of improving the language skills of reading, writing and understanding can be found in gaming software oriented on airport and aircraft maintenance. Students should be made aware of its demands in that sometimes it takes many more hours of maintenance compared to flight time an aircraft is in the air, such as with military helicopters. Most of these games are more cooperative-oriented, and allow students to test their own abilities either individually or in teams, and permit teachers to take on a more supervisory role, while allowing technically-educated students to test and develop their own analytical and cognitive abilities. As a precursor, one school in NYC, believing in its benefits, has even integrated video games into its curriculum to help teach thinking skills. [14] These benefits have also been verified through the research of Clarke and Ernest, who have looked at how games exercise analytical thinking, team building, multitasking and problem solving under duress [15] and by Nathan Murray in his transcript on How Video Games Improve Critical Thinking [16]. In general students use Virtual Maintenance Training to work with 3D simulations that replicate actual vehicles or devices with the objective of ensuring safety, reducing delays and cutting costs. And if budgets allow, the next step would be for future airport technicians and engineers to even be made acquainted with simulations of
IPad apps, similar to those introduced by Boeing in 2013 [17], giving them access to airplane manuals, part numbers, inventory and maintenance history.

5. Pilot-Controller Gaming and Second-Language Acquisition: A Practical Example

Among the many games available which can exercise more language training skills, there is a variant of an Air Traffic Controller game focused on Instrument Flying Rule conditions which was downloaded by the teacher because of its emphasis on speaking. Before its full implementation, it was most important to emphasize to the students that safety has the utmost consideration and that correspondence should most of all be standardized and clear. It was also good to remind students that both controllers and pilots are working together as a team, but in the ultimate situation the final decision should be made by the pilot.

This game was set up in thirty-minute blocks as part of a lesson where students were initially primed in which vocabulary and phrases would be used during different phases of air traffic movement, such as take-off/landing, in-flight situations, meteorological conditions, emergency procedures and taxiing. There is a great amount of incoming information processed by the senses, which is briefly held in the short-term memory, and students are required to select the most relevant data to make good decisions. In essence, students have to filter out information and effectively deal with only one message at a time. The regular format, which was set up, allowed both the teacher and students to mention, check and record the common human communication errors that result in most airplane accidents, between pilots and air traffic control, in written and spoken form, and mostly involving common hearback and readback errors, that is mistakes in understanding and transferring clear and precise information.

To give an overview of the above findings we can look at the series of logs which were completed during and after 30 minute-block sessions, and are enough in quantity to give us an idea on the effectiveness of peer to peer learning. They were used while supplementing regular tutorials in Aviation English, during which students periodically exchanged roles and were corresponding in a readback-hearback loop in one or two classrooms (using microphones). In the following tables you can compare the frequency of contributions and observations of both the teacher, mostly conveyed after the exercise, and students, mostly during the exercise.[See Tables 1 - 4].

With closer examination we can now look at how well the four basic language skills (reading, writing, speaking and listening) were exercised during various phases of the pilot-controller correspondence and draw conclusions from teacher observation and student feedback made during or after the lesson.

5.1 Listening

The listening aspect involved more teacher intervention than needed for the other language learning skills. It was kept in mind that according to Miller’s Law, a human’s working memory has a limited capacity and can remember up to seven pieces of information, plus or minus one or two at maximum [18]. During the lessons, the readability of the frequency was mostly kept constant within one or two classrooms, connected with microphones. However, various experiments with varying the degrees of readability, which range from 1 to 5, with "I hear you 5 x 5", meaning loud and clear. Although it is usual for one transmission to override another, dichotic listening experiments were done, with information coming into both ears, and with other students creating distracting background noise. More specifically based on prior experience and expectations, the experiments were done to focus on significant information, key words, and also the pitch of voice and tone of a message being transmitted.

Besides similarities between certain words such as "want" and "won’t" (it is recommended to use "will not") and "lose" and "loose", it was noticed that students had some problems recognizing some phrasal verbs which are not so commonly used in aviation terminology, such as “run up” (warm up an engine), confusing "push up" with "pull up" (meaning to pull the throttle towards oneself after landing), and in particular the words "go ahead" meaning to speak and not to move forward. Other findings included the
leaving out of prepositions, such as in the phrase "Hold short (of) runway 04" and "according (to) weather conditions", and hearing "cleared to take-off" instead of "cleared for take-off". A possible explanation for this is given by a study at The University of Southern Bohemia which cites examples of difficulties native speakers of Czech sometimes have in catching small connection words and prepositions, due to the inflection of their own language [19].

An interesting note was that some students stated it is better to do this type of activity with people who share the same first language and that they had more difficulties in understanding when exposed to specific dialects from around the world as when listening to recordings from various airports or in-flight recordings. Also connected to this, some sought the teacher out to verify the pronunciation of words pronounced differently in American and British English such as "direct" or "via".

5.2 Reading

Students can practice the reading aspect of language learning while gaming largely through perusing introductory instructions and being informed what to do next when moving on to higher levels of advancement. And it was both during the listening and reading parts that the students said they had learnt the most. Among the new vocabulary gained were words such as "empennage", "galley" and "fume", and new synonyms such as "orbit" instead of "circuit", "adverse" instead of "bad", "fly-by-wire" instead of "electronic", "furnish" instead of "equip" or "supply" and some new terms such as "dead reckoning", "lean fuel mixture" and "to bleed air": It should also be noted that there was also some confusion with aviation terminology when coming upon words with multiple definitions such as "pitch" (the longitudinal movement of an aircraft or the position of the propeller), "hold" (cargo space, or to stay in the same position), "flare" (a signal gun or the approach angle of landing) and "roll" (moving on the runway before and after a flight or the banking movement of an aircraft).

5.3 Writing

Data links, with which some standard messages can be automatically sent or created, are becoming more and more used as a safeguard against verbal communication loss in real aviation situations. Similarly student gamers are periodically required to contact each other electronically depending on the game used where they are required to write in instructions or responses, Most of these tasks required short responses and most spelling errors (mostly spotted by the teacher again) were connected to mixing up similar words such as "except" for "expect", "sealing" for "ceiling" (the height of the clouds) "altitude" (flight level) for "attitude" (the airplane’s position), "circle" instead of "circuit", and "breaking" instead of "braking". Other errors reflecting the difficulties of the non-phonetics of the English language and what students are used to hearing were with the misspellings "heigh", "weigth", "wind sheer", "fuel reminder", "maintinance", "intension" and "missfiring", and using "advice" for "advise". "Wilco" meaning "I will comply" was spelt "Willco" and the message transmitted when a plane is lost from the controller’s screen for more than thirty minutes INCERFA was written UNCERFA. (probably a mix-up with the word uncertainty).

5.4 Speaking

Among the spoken mistakes uncovered were for example saying "period" instead of "decimal" in giving a frequency or QNH (atmospheric pressure) reading, "outbound" instead of "inbound", confusing "ascend" with "descend" and "intentions" with "attentions", not announcing a full emergency, using past participles instead of simple continuous forms such as passed instead of passing, telling a pilot "to turn right" instead of "to turn left" or using a simple present statement (turns left) instead of the imperative form (turn left) and using "nine" instead of the standardized aviation appellation "niner". Also most students used the standard pronunciation of "three" and "thousand" when they should be the standard aviation pronunciation "tree" and "tousand". Despite this, students were also relatively good in spotting
when non-standard phraseology was not used. They pointed out the misuse of the term "alright" instead of using proper terms such as "roger" or "affirm". They also spotted a controller using the phrase "Forget it" instead of "Disregard".

Generally, among the most common errors detected by both the teacher and students were confusions due to call signs, pilot expectations and frequency changes, resulting in such things as altitude deviations, less than standard separation, giving the wrong aircraft accepted clearance, operational errors and heading and track deviations.

Also of interest, students were more amenable to take correction from the teacher in most cases, and from other students when errors did not involve phrases but numbers such as those used for flight levels, airspeed and headings. Only once or twice per four classroom periods did students catch their own mistakes and correct themselves without prompting from another student or the teacher.

Table 1. List of Errors Recorded on February 6, 2019.

| Type of error                             | Teacher | Other Students | The Student Him/Herself |
|------------------------------------------|---------|----------------|------------------------|
| **Readback Errors**                      |         |                |                        |
| Similar call signs confused (2 times)    | X (2 times) | X(2 times) | -                      |
| Runway excursion vs incursion            | X       | -             | -                      |
| "Cleared to" instead of "for"            |         | X             | -                      |
| Saying inbound and not outbound          | X       | -             | X                      |
| Saying "attentions" not "intentions"     | -       | X             | -                      |
| "no" vs "negative"                       | X       | -             | -                      |
| **Hearback Errors**                      |         |                |                        |
| Wrong runway in use                      | -       | -             | X                      |
| Wrong altimeter setting                  | X       | -             | -                      |
| Wrong airspeed for separation            | X       | X             | -                      |
| Using "nine" incorrectly                 | -       | X             | X                      |
| Giving the wrong heading                 | X       | -             | -                      |
| Giving the wrong flight level (via)      | -       | (X)           | -                      |
| New vocabulary                           |         |                |                        |
| perimeter fence, fly-by-wire, furnish,  | -       | -             | -                      |
| flare, to bleed air, to equip,           |         |                |                        |
| **Spelling mistakes**                    |         |                |                        |
| Wind "sheer", maintenance, circle vs    | X       | -             | -                      |
| circuit                                 |         |                |                        |

Table 2. List of Errors Recorded on February 13, 2019.

| Type of error                             | Teacher | Other Students | The Student Him/Herself |
|------------------------------------------|---------|----------------|------------------------|
| **Readback Errors**                      |         |                |                        |
| Saying PAN PAN PAN only twice            | X       | X             | -                      |
| QNH (pressure level) incorrect           |         | -             | X                      |
| Using "period" instead of decimal        | X       | X             | -                      |
| Confusing "lose" and "loose"             | X       | -             | -                      |
| Failure to request confirmation          | X       | X             | X                      |
| Failure to question instructions         | X       | -             | X                      |
| Type of error | Teacher | Other Students | The Student Him/Herself |
|---------------|---------|----------------|------------------------|
| **Hearback Errors** | | | |
| Using "forget it" instead of "disregard" | X | - | - |
| Saying Maximum Take-"of" Weight | X | - | - |
| Wrong frequency in use | X | | - |
| Saying "three" and not "tree" | X | - | - |
| Confusing "fill" and "fuel" | X | - | - |
| Saying "won't" instead of "will not" | X | - | - |
| Wrong heading given | X | | - |
| Similar call sign | X | | - |
| **New vocabulary** | | | |
| Dead recogning, roll (on the runway), adverse weather | | | |
| **Spelling mistakes** | | | |
| Severe thunderstorms, fuel reminder, weight | X | | - |

Table 3. List of Errors Recorded on February 20, 2019.

| Type of error | Teacher | Other Students | The Student Him/Herself |
|---------------|---------|----------------|------------------------|
| **Readback Errors** | | | |
| Giving no readback at all | X | - | X |
| Confusing "altitude" and "attitude" | X | - | - |
| Hold short (of) -not used | X | - | - |
| Wrong number of POB (persons on board) | X | X | - |
| Saying advice instead of advise | - | - | - |
| Wrong flight level in descent | - | X | - |
| **Hearback Errors** | | | |
| Wrong transponder code given | - | X | - |
| Saying "thousand" not "tousand" | X | X | - |
| "pitch" understood incorrectly | X | X | - |
| Wrong airspeed indicated | - | - | - |
| Saying "engine run out" instead of "engine run up" | X | - | - |
| Using "All right" and not "Roger or Affirm" | X | X | - |
| Confusing "push up" with "pull up" | X | - | - |
| Not using the imperative form "Turn left" but "turns left" | X | X | - |
| **New vocabulary** | | | |
| Orbit, pitch (of propeller) | - | - | - |
| **Spelling mistakes** | | | |
| Missfiring, wind sheer, breaking vs braking action | X | - | - |
Table 4. List of Errors Recorded on February 27, 2019.

| Type of error                               | Teacher | Other Students | The Student Him/Herself |
|---------------------------------------------|---------|----------------|-------------------------|
| Readback Errors                            |         |                |                         |
| Wrong flight level understood              | X       | X              | -                       |
| Wrong separation given                     | X       | -              | -                       |
| Not announcing a fuel emergency            | X       | X              | -                       |
| Entering wrong taxiway                     | X       | -              | -                       |
| According without "to"                     | X       | -              | X                       |
| Wrong aircraft accepts clearance           | X       | X              | -                       |
| Hearnback Errors                           |         |                |                         |
| In wrong sequence to land                  | X       | -              | -                       |
| "Go ahead" understood as "move forward" and not speak | X | X | - |
| Confusing weather abbreviations            | X       | -              | -                       |
| BECM and TEMP                              |         |                |                         |
| Confusing "ascend" with "descend"          | X       | X              | -                       |
| Saying turn left instead of right           | X       | -              | -                       |
| Using PAN PAN PAN instead of MAYDAY in emergency | X | X | X |
| Using "Repeat" instead of "Say Again"      | X       | X              | -                       |
| Taking off without clearance               | -       | X              | X                       |
| New vocabulary                             |         |                |                         |
| Empennage, fume vs smoke, (cargo)hold      | -       | -              | -                       |
| Spelling mistakes                          |         |                |                         |
| Maintenance, intension, WILLCO, UNCERFA    | X       | -              | -                       |

As you can glimpse from the tables all three target groups contributed something to the exercise in various ways. Although the gaming exercise was repeated with slight variations in regards to the number of pilots and controllers, it was the teacher playing a somewhat subordinating role in trying to gauge the contribution of peer to peer learning, who most often spotted errors the students didn’t. In contrast the participating or observing students usually immediately spoke up when they detected something wrong, and mistakes were mostly corrected but sometimes repeated. One can see that allowing students to rely on themselves during focused gaming has a partial role to play in enhancing motivation, learning new vocabulary and making the classroom more fun, but it seems that no matter what facilitating role the teacher has, students will mostly tend to defer to his/her opinions and observations in the long run.

6. Conclusions

Students wanting to improve their proficiency in aviation English, whether it is in only reducing hearback and readback errors, can practice it on-line in a classroom environment. And it mostly depends on whether a student is spending his/her time shooting down enemy aircraft, or directly or indirectly learning how an engine works, or using a mouse to place him/herself behind a cockpit control column. As shown in the gaming exercise focused on aviation, a teacher can enhance a lesson from time to time by stepping back and allowing the students themselves to reinforce and clarify responses and find the
answers themselves. As to the future development of gaming software focused on airport management and maintenance it will depend on the incorporation of more language learning skills to have them implemented more in the classroom. In regards to air traffic controller and pilot gaming, once mastered locally the next step would be to involve other learning institutes if the scheduling, curriculum and facilities are compatible. Whatever type of activities gives students a chance to feel more comfortable and confident in second-language speaking activities, which can create momentum to promote student-oriented learning in and outside the classroom. It also allows the teacher and students in different degrees to be guides in the learning process, which can prevent mistakes from being repeated and reinforced, as there are few standard, corrective measures when gaming in a second language outside the classroom.

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