ADVENTURE GAMING: ITS ROLE IN LANGUAGE LEARNING AND THE DEVELOPMENT OF ANALYTIC ABILITY

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INTRODUCTION

Throughout the 1960s and 1970s, the world of communication arts, including foreign language training, witnessed a great proliferation of language laboratories, many of which have been abandoned because of their intimidating control rooms and row upon row of isolated booths for the learners. It was believed that repetition of taped language would not only help the teacher reach more students, but also provide the learner with needed practice. Indeed, to some extent these language laboratories have fulfilled their promise, but they have never become a place where students willingly go. One of the main reasons for this is the non-communicative nature of a tape recorder; it can never appropriately *respond* to anything it *hears*, that is, anything a student may say. Only in cases where there is a completely controlled conversation, with the tape recorder playing the lead and the learner playing the other part, can it even seem like there is anything like a conversation going on. However, if the learner makes a mistake or deviates from the preset conversational path, there is no correction nor query as to what was meant. If the learner asks a question, no appropriate taped answer is forthcoming; as far as the tape is concerned, the conversation is proceeding quite nicely. It may seem

unfair to criticize the tape recorder for something it obviously cannot accomplish, but it is precisely because it cannot interact with the user, nor respond when the user is determining the flow of communication that the greater majority of students of language find it so irredeemably boring.

In its ability to be contextually conversant, the computer greatly exceeds the limitations of the tape recorder, and offers interesting communicative instruction and enjoyment. It is this context sensitivity that most nearly maps actual human conversation, and therefore provides us with a clue as to why computer-assisted learners so easily invest so much affect in their electronic study. One almost never sees students become violently angry at or excited about a book they are reading; however, it is extremely common for software users to visibly manifest signs of the various emotional states they are going through as they study and control what is presented on the computer display. The fact that a user can exercise some modicum of control over the progress of the computer program provides us with another clue as to why computer-based educational software can be captivating. Of course, there are limits to a computer's ability to respond appropriately. Currently, a computer will not say, "God bless you," when you sneeze, but it will respond appropriately (depending upon the sophistication of the program) to relevant statements, irrelevant comments, and to mistakes. With current modestly priced technology, oral input is not yet available; however, audio output is, along with text input and output. Text input, of course, is accomplished through the keyboard, and text output is presented on the computer display.

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For the past several years, I have been researching the effects of computer-aided language learning (CALL), comparing them with the effects of more traditional forms of learning. The first long-term experiment used ***Opposites***,[1] a vocabulary builder that I designed; the subsequent research involved two experimental groups: one that studied a list of paired idioms using only a previously prepared printed dictionary, and the other using only a computer and previously prepared software covering exactly the same group of paired idioms. The contents of the computer software and the dictionary were exactly the same, including the meanings and sample sentences. All the subjects in both experimental groups were pretested to insure that neither group was starting out with an advantage. Their learning curves and retention curves were plotted over a period of two years. Statistical analysis of the data revealed that although 'book learning' allowed for steeper learning curves, the computer program covering the same material provided the subjects with a statistically significant longer retention of the material they had learned. The difference in the mean loss of retention was 11.6 percentage points. With a $t=4.1$,[2] this is statistically significant at any level of significance.[2, 3]

The research cited above was a strong indication to me that there was something dramatically different about the way the learner reacted when studying in a traditional way and when studying with the aid of a couple of boxes filled with some kind of electronic salads. In 1984, I became intrigued by the possibilities latent in adventure games which not only provide an interesting graphic environment, but also an interactive language environment. I was instantly captivated by the idea that adventurer/players could be so caught up in a game

that they would lose all sense of time . . . imagine what this could mean for education! I began to contact software houses in search of a commercially available adventure game that neither used elliptical English sentences like "Go door," or "Take ring," nor numbers to indicate the player's choices. For native speakers, either one of these techniques is quite OK; however, for language learners, practicing the kinds of sentences illustrated above would only help them learn an incorrect pattern: article deletion, and repeating it again and again would only reinforce it. Just choosing numbers would in no way aid them in developing their own ability to construct correct sentences. Because, at that time, I was unable to find a single game that met my requirements, and because I perceived the need of a new type of game, I designed what I believe is the first and, even at this writing, the only adventure game to use only correct, practical English sentences that the adventurer/players must create themselves. My goal was to try and conceal some teaching in the game, for the idea that students could be so absorbed in a game that they would have no idea that they were learning anything was very appealing.

GENERAL EXPLANATION OF ADVENTURE GAMES

Generally, an adventure game, played on a computer, revolves around a story which is known, at least, in part, at the very beginning of the game. The player/adventurer, who is usually the good guy, is given a list of goals to accomplish, but is not told exactly how to go about achieving them. By searching for, collecting, and using the things hidden in various areas in the game, and by

overcoming other obstacles, the player/adventurer gradually works toward achieving each of the goals. At each location, after looking at the picture on the computer display, and reading the words that also appear on the display, the player is required to think about what to do. After thinking, s/he types in their idea. For example, if the player saw a box, s/he might type in, "Open the box," "Look inside the box," "Move the box," or "Take the box." If the adventurer/player saw a ladder, s/he may type in, "Climb up (or down) the ladder," or "Take the ladder." If an adventurer/player found him or herself in a room, they would typically check each thing in the room, gather information, and try to work with each of the things they had found. Each time the player/adventurer types in an idea and presses the ENTER key (the key with the arrow bent to the left), the computer processes the sentence that they typed in, and then, either gives a message and follows the instruction, for example, opening, moving, or showing the contents of the box on the screen, or indicating that the player now had the ladder, or providing some other relevant information. In other cases the computer provides some kind of hint or error message. Hints, of course, would help the adventurer/player focus their attention on relevant tasks. An error message tells the player/adventurer that his or her previous sentence couldn't be understood by the computer. Movement around the game environment is accomplished by indicating in which direction they want to go. If it is possible to go in the direction indicated, the scene changes; if not, the adventurer/player is either told that they can't go that way at that time, meaning that they can after completing some task(s), or that it is impossible to go that way. Typically, when seeking information, characters that appear in the game can be asked either directly or

indirectly with sentences like "What do you know about the missing ring?" or "Ask the man what he knows about the missing ring." Additionally, various characters may ask the adventurer / players questions to which they must respond before moving on or attending to something else.

In order to function well in a game environment, it is of paramount importance to formulate a strategy; this strategy will include, among other things: becoming thoroughly acquainted with the manual, mind set (the way to think about the game and one's role), a list of things to do in each and every area so as not to miss anything important, note taking, and map making. Thus, an adventure game provides an exciting, varied, yet repetitive blend of viewing, reading, imagining, logic and memory exercise, sentence formation, and typing in a highly motivated environment. Of course, the majority of sentences that are typed in are in the imperative mood; however, not all, and when working in pairs or in groups, adventure gaming provides a very strong stimulus for a great deal of conversation. Adventure gaming is so captivating that adventurer/players find themselves preoccupied with the game, reviewing the scenes, figuring out the hints and explanations, and reworking their input until they have unraveled each and every secret.

THE LAND OF EPIGENE

Designed for non-native speakers of English from the low-intermediate to advanced levels, ***The Land of Epigene***[1] is the title of the computer-based adventure game that I created, typical in that the

player/adventurer is presented with an engaging graphic environment and explanatory text, atypical in that s/he is required to use commonly spoken, yet correct, English.

Inhabited by lovely Princess Unnerva, and her brother, Prince Prensio, and a number of larger than life animals, the Land of Epigene is ruled over by the wickedest of witches, none other than Repugnance, herself. The list of her deeds is long and terrible; she has already succeeded in killing the King and the Queen; but before they died, they were able to protect their beautiful daughter and precious son by sealing them in two different areas where Repugnance could do nothing to harm them.

The Land of Epigene is an adventure game that takes courageous adventurers through an interconnected maze of rooms and locations as they work toward their goals of finding and freeing Prince Prensio and Princess Unnerva, and, of course, killing the wicked witch, Repugnance . . . enough mental exercise and excitement to make the adventurer/players feel like they were on a real adventure.

There are five types of on-line help available: 1. a recap of the story line, 2. general instructions, 3. a list of verbs used in the game, 4. the inventory of the items collected, and 5. indication of whether or not the adventurer/player is finished in the area. This last type of on-line help also provides hints as to what has been left undone if anything. There is also a saving function which allows the adventurer /player to save the portion of the game s/he has completed, so at their next session, they can begin where they left off.

USING *THE LAND OF EPIGENE* AND RESULTANT LEARNING

Up until the present, ***The Land of Epigene*** has been used in a number of ways, both in and outside the classroom: free access, course-centered activities, and course-related activities. Free access is the simplest; students are just given a copy of the game and the manual. Whether they choose to take it home or play it on campus individually or in groups can be decided by the instructor and/or the student/players. As the manual contains chapters designed to help not only those who have never touched a computer before, but also those who have never played an adventure game before, even true beginners can get started and complete the game without instructor assistance.

This particular adventure game has been used in two different kinds of course-centered activities: one focusing on it purely as a computer program, and one focusing on it as an adventure game. As a computer program, it exemplifies various programming techniques that come together to make a unified whole; graphics, tiling, animation, text recognition, error message handling, chain merging, music that does not require a sound board, and many other techniques are amply demonstrated throughout the whole program. All too often, programming texts concentrate on dry, sometimes useless, mathematical formulation only, thus convincing many would be programmers that computer programming and software development is not very interesting.

Focusing on ***The Land of Epigene*** as an adventure game, an academic course can begin with some classes to first acquaint the

students with computers, their parts and their operation; this is handled in Chapter One of the manual. A hands-on approach does a lot to relieve the students of any fears and irrational presuppositions they might have concerning computers. The next few classes may deal with just what an adventure game is, how they usually work, and what kind of thinking is helpful to a successful adventurer; this material appears in Chapter Two. After the students understand the basics of handling a computer and what an adventure game is, they are then ready to acquaint themselves with the last three chapters of the manual. Because of computers' varying processing speeds, Chapter Five covers the use of a utility program that can be used to adjust the speed of the music and the length of time messages are displayed on the screen. Once the on-line instructions, which also appear in Chapter Three and Four, have been read . . . and understood, it should take from around 10 to 20 hours to complete the game. The final class meetings can be devoted to recapping the kinds of strategies that worked well, where they found what, how they used each of the things they found, why they couldn't find everything in the game, how they felt at various stages, and general comments about the game.

Using the game in course-related activities, allows for unlimited flexibility. It can be used in studies of logic, problem solving, fear, courage, and heroism; as well as providing practice in giving and getting directions. In so far as it exemplifies various facets of a culture, the game, without focusing on them, can also acquaint students with them. One of the most recent examples of how the game can be used as a culturally specific course-related activity comes from a professor at Osaka University who first had his students read

novels revolving around a hero. He then had them play ***The Land of Epigene***, of course, playing the part of the hero. After this experience, he questioned them on paper, playing the part of a newspaper reporter, and wanting to know about various aspects related to their heroic adventure. A variation on this type of format would be for the adventurer/player to maintain a journal of his or her encounters while adventuring, much the same as real-life adventurers have done.

Because I have wanted to provide my students with an environment in which they feel it natural to converse in English, I have built a mini-lab with six workstations in my university office. Five of the workstations are available by reservation, and one is used on a first-come-first-served basis. I first require the students to reach some level of proficiency using the three dictionaries (elementary, intermediate, and advanced) included in ***Opposites***, the vocabulary enhancer mentioned above, and then to complete ***The Land of Epigene***. Students are provided with disks and manuals at the beginning of the academic year; they are then given a time frame within which to complete each of the programs. The time frames are always more than adequate, considering the number of students using the programs, the time needed to complete each of the programs, and the number of computers available. They are required to read the relevant manual *before* they begin to use the program. Because I'm usually on hand to answer questions, this arrangement has worked out very well. Students are also required to speak only English in my office, a situation that most grow to like. Thus, by creating a friendly English-speaking work environment, students can not only come to use English in a more natural way, but also benefit from their acquaintanceship with

computers and educational software.

In addition to learning about programming, logic, directions, and problem solving (to name a few); here, let me present some further comments about the type of learning taking place when playing an adventure game. Japanese students usually learn foreign language vocabulary through translation. However, when presented with a graphic environment, written explanations, and a verb list (one of the types of help available in ***The Land of Epigene***), students can form associations. For example, when looking at a ladder, the words *use* or *climb* may come to mind; when seeing some soup, the words *stir, drink*, or *taste* can become fused with the image; and when encountering any kind of a container, the words *open*, or *look inside* are immediately coupled with the object. Of course, a similar kind of association is being formed between objects in the game and their names; each time an adventurer/player enters an area, s/he is presented with a description of the area. This repeated pairing of graphics and vocabulary leads to a lasting association, not of word and word, but of word and object (mental image). In addition, because the adventurer/players are goal directed, absorbed in winning, investing their affect, and often repeating segments of the game, these word-image associations are further strengthened. Additionally, players receive guidance and hints not only from the area descriptions and the answers the computer provides for each input sentence, but also from the various types of help that are available from any point in the game by typing in the appropriate phrase.

RESEARCH - 1987 to 1991[5]

In April of 1987, I completed Version 3.00 of ***The Land of Epigene*** and was able to lead over 100 university students, ranging from freshmen to seniors, on their first adventure. They were split into four experimental groups of paired teams, each of which was given a notebook and a copy of the program. Group 1 (N=24; 12F*inished* +12UNf*inished*) was instructed to record: 1. the date and total time played, 2. the places visited and the things found, 3. the number of times killed, and 4. all the sentences entered into the computer. After each session, they were allowed to save the game at the point they had ended. Being able to save the game meant that the computer would record all the things that had already been collected plus the area the player/adventurers were in when they stopped playing at the end of a session. Thus, when they resumed playing at the following session, they could begin where they had left off. Group 2 (N=31; 16F+15UNf) recorded everything in the same way; however, they were not allowed to save the game, so they were forced to begin at the beginning of the game at each session. Group 3 (N=22; 5F+17UNf) was allowed to save the game, but not allowed to record all that they had typed into the computer (this combination of saving but not recording seemed to be the most aggravating, judging from the high percentage of subjects that quit from this group). Group 4 (N=25; 11F+14UNf) was neither allowed to record their input, nor to save the game. There was a statistically significant higher percentage of Group 3 members that did not complete the game, but there were no other statistically significant differences among the groups.[2,4] I had expected that there would be some significant differences with respect

to retention; however, there weren't, most likely due to the fact that the adventurer/players didn't conscientiously follow my instruction to "*not* talk to anyone, except your partner, about the game." Of those that finished the game, 91% admitted that they had talked to someone about the game; in 36% of those cases, they said that they had revealed important contents of the game. 79% of those who did not finish the game also admitted to talking about the game, with 19% revealing important contents. In checking the corresponding answers on the questionnaires given to the controls, it became apparent that they had been left in the dark; the subjects in the experimental groups only talked about the game with others who were also in one of the experimental groups. Many later confided that the game was too challenging and interesting to keep it to themselves.

In addition to the data gleaned from the notebooks, quite an exhaustive questionnaire (covering retention, self and partner assessment, motivation, how they view problems, how they felt about the game, and whether or not they followed the instructions) was administered to all four experimental groups as well as the control group. The results of the data collected indicate, among many other things, that of those who volunteered to try the game, nearly 100% found it interesting, and 73% (89% of those who finished, and 62% of those who did not) found that it had helped them in some way. In descending order, they felt that they had increased their vocabulary (42%), heightened their ability to choose appropriate words in given situations (23%), increased their typing speed (14%), and enhanced their ability to use prepositions accurately (8%). I was hoping (secretly) that they would report some greater facility in handling

articles, but no one did, except privately. In addition, 80% of those who finished and 64% of those who did not indicated that they wanted to play the game again.

Of those that experienced some kind of block to their progress, 25% of all the subjects in all four experimental groups reported deficiencies in their intellectual abilities, imaginations and creativity. 14% said it was time; 8% blamed the computer; and 29% of those who did not finish the game mentioned that their lack of ability in English, including a poor vocabulary, was to blame. In explaining how it was that they could complete the game, those who finished cited their interest, eagerness to see how the game ended, not wanting to leave something half done, and good partners as the main reasons. The overwhelming majority of those who did not finish the game said it was due to a mismatch in their and their partner's schedules, and due to their own busy schedules.

In considering motivational factors, it is interesting to note that there was a very marked shift from challenge to troublesome to threat as we pass from those who finished to those who tried but didn't finish to those who didn't even want to try. Those who didn't even want to try automatically became the control group, 42% of whom felt that any kind of a challenge was troublesome, and 8% of whom felt threatened.

In trying to determine who it was that actually contributed most to the success of the game, a number of questions were asked of each of the participants. As we can expect here in Japan, 93% of those who

finished and 97% of those who did not indicated that their partners had helped. When asked who found most of the answers, the percentages changed for those who had completed the game to 36% for the partner, 20% for the one answering, and 25% for both. For those who did not finish the game, the percentages became 33%, 12%, and 38%, respectively. And finally, when asked who was more talented at the game and who was poorer at the game, 65% indicated equivalence.

Overall, 36% of those who finished the game and 53% of those who didn't felt that they had followed the instructions they were given (the instructions that were given specifically to each experimental group, as well as those that were needed to play the game). The fact that 54% of those who didn't finish the game felt that they had followed the instructions, leads me to wonder whether or not the instructions accompanying version 3.00 were sufficient. Further, only 17% of those who were unable to finish admitted to cheating in one way or another, while 34% of those who finished admitted to cheating. One of my assistants who oversaw the research project believed that the higher incidence of cheating and the lower rate of following the instructions among those who finished the game was due primarily to their higher interest and drive to finish.

Even though no one was told what the purpose of the game was other than what was expressed as goals for the game, namely: find the princess, prince and king; kill the witch; and keep yourself alive, many other answers emerged in addition to the 28% that believed that the purpose was just that. 41% of those that finished thought that the purpose was somehow related to the improvement of their English

skills, while 53% of those that did not finish also believed so. Others thought that the game was related to typing skills, dealing with computers, imagination and creativity, thinking and logic, and my research.

RESEARCH - 1991 to 1993[6]

Rather than focusing on the mechanics of the game, partner interaction, and language education as I had done in the research completed during the 1987 to 1991 academic years, with version 5.00 of ***The Land of Epigene***, I have tried to determine if the playing of an adventure game can facilitate analytic thinking. Because adventurer /players are absorbed in their task, goal directed, and presented with various types of puzzles which require solving, I felt it was reasonable to suppose, in addition to the gains mentioned above, that their analytic ability would appreciate to some extent.

Two tests (Test A composed of 18 questions, and Test B composed of 17 questions) were compiled from: 1. the analytical and analogical sections of former Graduate Record Examinations that appeared in How to Prepare for the Graduate Record Examination,[7] 2. logic puzzles that appeared in Logic Puzzles,[8] and 3. logic/logistic problems composed by me. Questions #7 to #13 comprised the analogical sections of both tests. Questions #1 to #3, #6, #14 to #16, and #18 comprised the analytic section of Test A; with #1, #3 to #5, and #14 to #17 comprising the analytic section of Test B. The puzzle section of Test A was composed of #4, #5, and #17; that of Test B, #2 and #6.

In April of 1991, class 2B began to play ***The Land of Epigene***; all but 3 finished by the beginning of September. In mid-September of 1991 classes 2A, 2B, 3A, 3N, and 4 were given Test A as a pretest. Class 2A then began to play the game, finishing by mid-January, actually only 8 students finished. Classes 2A, 2B, 3A, 3N, and 4 were then given Test B as a post test.[9]

In mid-May of 1992, Test B was administered to classes 1A, 1B, 1C, and 2C as the pretest. Class 1A then began to play the game, all but 3 finishing by early September. Test A was then administered to classes 1A, 1B, 1C, and 2C as the post test. Class 1B then began to play the game; all but 1 finished by mid-December.[9]

All the tests from all the students, both experimental and control groups, were then corrected and rechecked according to a uniform scoring plan. If a student was unable to take both tests (pretest and post test), the one s/he took was returned to her or him. The remaining tests were paired, pretest with post test, for each of the 229 students that had taken both. Using SPSS/PC+ Data Entry, a data base was set up and used to generate statistical data.

Test A and Test B were themselves tested to see if there was imbalance in them or their component parts. The mean for the analogy section of Test A was 50, while that of Test B was 66; this of course, was statistically significant, meaning there wasn't a good balance. The mean for the analytic section of Test A was 76; for Test B it was 77, balanced. The means for the puzzle section were 26 and 13, respectively for Test A and Test B, again a statistically

significant difference.[2] For the tests taken as whole, there was a statistically significant difference; the mean for Test A was 61 and for Test B, 64; the difference of the two means was only 3 points on a 100-point scale. The analogy section of Test A proved to be more difficult, while the puzzle section of Test B proved to be more difficult. There was good balance in the analytic section which comprised a little more than half of the test. Overall, the 3-point spread notwithstanding, the two tests were not impossibly unbalanced. However, for the 1991-92 participants who took Test A and then later Test B, we can expect a few points to be added to those that accrue to the practice effect. Conversely, for those who participated during the 1992-93 academic year, those points will be subtracted from any gains owing to the practice effect because they took Test B first followed by Test A (the more difficult of the two). This all means that statistically significant gains overall, and in the analogy section in particular, will be marginally more difficult for the groups that participated during the 1992-93 academic year.

Because the ability to solve analytic and logical puzzles increases with age and experience, we can expect older students to do better than younger students, and indeed, this is the case to a point. Across the board, only the juniors (all controls, labeled as 4; see above and Note 9) did consistently better than all freshman and sophomore groups, whether experimental or control. Against this supposition, the sophomores (all controls, labeled as 3A and 3N; see above and Note 9) didn't do consistently better than the freshmen. In fact in only 4 out of 31 tests of statistical significance did 3A do significantly better.

The 1991-92 freshmen (labeled as 2A) were the experimental group for that academic year; however, only 8 out of 27 actually finished the game. As a consequence, of course, as a class they didn't do significantly better in any of the tests of significance, except when compared to one sophomore class, labeled as 3N. 3N was a control and didn't do better than any group it was compared to.

The 1991-92 freshmen (labeled as 2B) first played the game and then took the pretest followed by the post test. They scored significantly better than 1B on the analogy section and overall scores for Test B (2B's post test). 2B also did significantly better than 1C in the analogy section of Test A, and better than 3N in all tests of significance, except for the analogy section of Test A where 3N reached a slightly higher mean. 2B's average scores were higher than the groups they were paired with in 30 out of 64 tests for significance.

The 1992-93 freshman class (labeled as 1A) was the experimental group for that academic year. All but 3 finished the game, thus putting them in a position to provide some further evidence to support our contention that properly constructed adventure games may nurture our analytic abilities. 1A did significantly better in the analogy section of Test B than 1B, 1C, and 3N; better than 1B and 3N in the analytic section of Test B; and better than 1B and 3N in the overall comparison for Test B. These scores, however, to some degree, mitigate against our thesis because Test B was used as the pretest. Only for 3N was Test B the post test, indicating only that 1A started out in a stronger position than 3N had achieved even with any gains owing to the practice effect.

In Test B, the pretest for 1A (the 1992-93 experimental group) and the post test for 2A (the 1991-92 experimental group), their scores were rather evenly matched; however, in the post test (Test A), 1A did significantly better than 2A in the analytic section, and overall. Also in the post test, 1A did significantly better than 2B in the analytic and puzzle sections, as well as overall. 1A also did significantly better in the analytic and puzzle sections, plus the overall measure of significance when compared to 3N. The fact that Test A (1A's post test) was significantly more difficult statistically than Test B (1A's pretest) adds some further significance to their gains. 1A did better than the groups they were paired with in 37 out of 64 tests for significance, including those reported above.

CONCLUSION

The Land of Epigene has demonstrated that a computer-based adventure game can provide language education backup through an entertaining, responsive medium. In addition, while the data gathered and the statistical analyses generated don't allow for *complete* certitude, they do provide definite support for the contention that adventure gaming can strengthen adventurer/players' analytic ability. With its interactive language environment, its absorbing appeal, and challenge, adventure gaming can indeed enhance not only language skills. We can realistically conclude from the above that properly constructed adventure games will yield similar or superior results.

NOTES & REFERENCES

1. NEC PC-9800 series computers were used in the development and running of the software, ***Opposites*** and ***The Land of Epigene***, and in the development of the 97-page manual ***User's Guide to Opposites***, as well as the 47-page manual ***A Guide for Adventurers in the Land of Epigene***. The manuals were authored by me with artistic help from Mr. Teruhiko Oshima; the software was designed and developed by me with the technical aid of Dr. Masaki Manabe of Oita University. All of the computers used by those in the experimental groups were equipped with 14-inch color screens and filters (to block gamma, X-ray, and UV waves; as well as to prevent the build up of static electricity which is one of the primary causes of 'red eye' in computer operators). Each of the games occupies about 700K of space on a floppy disk. Each of the subjects in the experimental groups was provided with their own copy of the game and the manual. With the exception of 2, all students came to my office during their free time to play the game.

2. According to commonly accepted statistical theory, any value less than .050 is considered statistically significant. The figure .050 can be understood to mean that there is only a 5% probability that the reported differences are due to chance; and therefore, we can be 95% sure that the differences in the compared groups' means or averages are due to a real difference. Accordingly, a value of .000 would be the strongest indication that there was a real difference between two group means; a value of .500 would show that there was a difference, but that it could easily happen because of chance differences; and a value of 1.000 would indicate that there was no difference at all.

3. Portions of this information originally appeared in: Nelson, W.R., "It's the Books Against the Computers! Who Wins?", *Journal of Osaka University of Foreign Studies*, 70-1(1985), 41-53. This article contains the learning and retention curves for each experimental group, as well as, all the computed *t*-scores.

4. Statistical analysis, including frequencies, means, and most importantly the T-Test to determine significant differences between means, was performed on an IBM compatible Gateway 2000 486/33C using SPSS/PC+ Data Entry and SPSS/PC+ Statistics. SPSS stands for Statistical Package for the Social Sciences.

5. Portions of this information originally appeared in a presentation *Adventure Gaming - Its Role in Language Learning* I gave at a Japan Association of Language Teachers' Conference (JALT) in Omiya, Japan in 1991.

6. Portions of this information originally appeared in: Nelson, W.R., "Adventure Games - Their Place in Language Education and their Relation to Analytic Ability", *Integrated English Area Studies* of Osaka University of Foreign Studies, (1993), 23-42. This article contains the tables of statistical significance computed when comparing the various groups.

7. Brownstein, Samuel C. & others. *How to Prepare for the Graduate Record Examination*. 8th ed. New York: Barron's Educational Series, Inc, 1988.

8. Duncan, A.J. & Gresty, A. *Logic Puzzles.* London: British European Associated Publishers, Ltd., No. 33 (1986).

9. Class labels are all reckoned from the 1992-93 academic year, with 1 indicating freshmen, 2 sophomore, 3 junior, and 4 senior. Accordingly, those groups with a '2' were freshmen during the 1991-92 academic year; those with a '3' were sophomores, and so on. A, B, and C only indicate that the class was divided into 3 groups; N indicates that it was a evening-division class.

Portions of this information paper also originally appeared in: Nelson, W.R., "Take Your Students on an Adventure", *Chart Network*, 1-1(1990),12-14, Suken Publishing Co.

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