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**TEACHING L2 VOCABULARY THROUGH LOGIC PUZZLES**

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*This article presents the idea of using logic puzzles as a task-based teaching technique in foreign language classrooms to foster second language vocabulary acquisition. The general advantages of using logic puzzles are that they can be both mentally challenging and fun for students while producing numerous pedagogical benefits. These benefits are believed to include an increased exposure to vocabulary presented in specific contexts with a distinct focus on comprehending meaning, a heightened mental engagement with the key vocabulary at a deep level of processing, and the fostering of inference skills and the ability to guess meaning from context, all in a relatively brief amount of class time. Furthermore, logic puzzles offer a great deal of adaptability in exactly how they are utilized in class. Ultimately, it can be concluded that logic puzzles should be explored more thoroughly for their potential benefits to classroom teaching and the learning of foreign languages through continued use and more substantial research studies.*

*Key words: logic puzzle, scenario, clues, deduce, task*

*Este artículo presenta el uso de problemas de lógica como una técnica de enseñanza de lenguas extranjeras a base de tareas, para fomentar la adquisición de vocabulario. Las ventajas generales de los problemas de lógica incluyen el hecho de que son desafíos mentales y también el hecho de que son tareas divertidas para los alumnos, al mismo tiempo que se obtienen beneficios pedagógicos. Estos beneficios incluyen una alta exposición a un vocabulario presentado en contextos específicos y con un énfasis en la comprensión de significado; su valor como actividad en la que el estudiante*

*tiene que procesar el vocabulario a un nivel profundo y utilizar la habilidad mental de inferir el significado a través del contexto; y todo esto en un tiempo relativamente breve. Además, los problemas de lógica son muy flexibles con respecto a cómo se utilizan en clase. Para terminar, se puede concluir que la utilización de problemas de lógica y sus beneficios potenciales en la enseñanza y adquisición de lenguas extranjeras merecen una investigación continuada y más profunda.*

*Palabras clave: problema de lógica, situación, indicios/pistas, deducir, tarea*

### 1. Introduction

Logic puzzles or logic problems, commonly associated with mathematics, are word or story problems which present a scenario and an objective to be deduced through the piecing together of information given in clues. The simple example seen in Figure 1, “Sightseeing in Seville”, may help to clarify exactly what constitutes a logic puzzle for the purposes of this discussion.

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Three tourists in Seville (Andrew, Eric, and Meg) each visit a different famous sight (the cathedral, the palace, and the old tobacco factory). From the given clues, determine each tourist’s name and sightseeing destination.

1. Both Andrew and Eric paid money to enter their sights.
2. Neither Eric nor Meg visited the cathedral.
3. Meg met a lot of smart students at the sight she visited.

Tourist	Sight
Andrew	
Eric	
Meg	

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*Figure 1: "Sightseeing in Seville" Logic Puzzle*

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This simple logic puzzle presents the reader with the objective of matching each tourist with the sightseeing destination visited. Given the stated scenario, subsequent clues, and a general familiarity with the three sightseeing locations mentioned, it should be relatively easy to deduce the solution. From the information presented in the first clue, combined with a limited knowledge of the three sights mentioned, it can be determined that neither Andrew nor Eric could have visited the old tobacco factory because it does not require an entrance fee. As a result, we can deduce that Meg must have visited the old tobacco factory and, therefore, could not have visited the cathedral or the palace. This deduction is confirmed by the information presented in the third clue as it can be inferred that Meg must have visited the old tobacco factory, which is currently used by the University of Seville. While the first and third clues lead to the deduction that Meg visited the old tobacco factory, the locations visited by Andrew and Eric remain yet unknown. The second clue reveals the final piece of information needed to solve this logic puzzle as it reveals that Eric did not visit the cathedral and, therefore, could only have visited the palace. Thus, with the sightseeing destinations of both Eric and Meg accounted for, it must be logically concluded that Andrew visited the only remaining sight, the cathedral.

While perhaps not necessary for a simple logic puzzle with only two sets of variables to match as in this example, the use of a crosshatch grid, as seen in Figure 2, is often helpful in clarifying the information presented in logic puzzle scenarios and clues. Such grids can be used to track the reader's working deductions as the clues are presented by clearly showing which matches have been ruled out, signified by "X", which matches remain possible, signified by blank squares yet to be filled, and which matches are believed to be confirmed, signified by "O". Figure 2 shows how the solution to the "Sightseeing in Seville" logic puzzle would look on a crosshatch grid.

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	Cathedral	Palace	Old tobacco factory
Andrew	O	X	X
Eric	X	O	O
Meg	X	X	O

*Figure 2: "Sightseeing in Seville" Logic Puzzle Grid*

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The use of crosshatch grids to clarify the information presented in logic puzzles becomes increasingly important as the puzzles become more complex. While the logic puzzle in Figure 1 is relatively simple because it only presents two sets of variables to match: tourist names and sightseeing destinations, an increase in the number of variables or sets of variables would serve to increase the complexity of the puzzle. For instance, the puzzle in Figure 1 would become more of a challenge if another piece of information, such as the color of each of the tourist's shirts, was added as another set of variables to match or if more variables were added to the initial set as by adding another tourist's name and sightseeing destination into the puzzle's basic scenario. The relative difficulty of a puzzle can also increase if the variables are not presented overtly in a parenthetical list but, instead, must be gleaned only from the given clues. Clearly another factor that affects the level of difficulty of logic puzzles is the familiarity of the reader with the context of the puzzle, as evidenced by the general knowledge about Seville needed to understand the solution to the puzzle presented in Figure 1. The range of complexity offered by logic puzzles allows for the

challenge they present to readers to remain even as the reader becomes more proficient in solving them.

## **2. Rationale**

To be clear from the outset, the use of logic puzzles does not represent a groundbreaking approach to language pedagogy. On the other hand, their potential value as an effective language learning technique should not be overlooked either as there are many reasons why they can be considered as useful classroom activities that may assist in language learning and second language vocabulary acquisition. As logic puzzles are basically tasks in which learners must make sense of information presented in the basic description of the scenario and subsequent clues, understanding the meaning of the information presented is crucial to one's success in solving the puzzle. As a result, the use of logic puzzles may be considered as consistent with the tenets of task-based instruction, an approach which has risen to prominence in applied linguistics over the past 30 years. While there is a lack of consensus in the field about what actually defines a "task" in task-based instruction, central components to most definitions seem to follow Skehan's (1998, p. 268) suggested criteria:

- Meaning is primary.
- There is a goal which needs to be worked towards.
- The activity is outcome-evaluated.
- There is a real-world relationship.

Although task-based instruction is generally associated with communicative tasks, it seems that logic puzzles, which are primarily reading comprehension and logical deduction tasks, also satisfy Skehan's proposed criteria. While this point is not critical to understanding the potential value of logic puzzles in language teaching, it does work to further justify their use as a compelling language teaching technique worthy of consideration.

The fact that the idea of using logic puzzles for language teaching is not new and has undergone limited experimental testing with positive results also points to their potential value to the field of applied linguistics today.

Indeed, direct mention of logic puzzles as tools for foreign language instruction can be traced back to articles by Danesi (1979) and Jewinski (1980). In his seminal 1979 article on the topic, Danesi outlines the three reasons why puzzles should be considered as viable supplementary activities in language teaching, and it seems that this rationale is still applicable today. First, Danesi contends that most people enjoy the challenge of solving puzzles which do not demand advanced calculations or specific technical skill. The current widespread popularity of *sudoku* puzzles seems to provide support for the relevance of this claim remaining intact today. While ensuring that learners find class material enjoyable may not be an absolute necessity for a technique to be effective, if an activity can be both fun and educational at the same time, it seems only sensible to capitalize on this somewhat unique set of teaching and learning circumstances in the classroom.

Secondly, Danesi (1979) points to the fact that most language students already have some knowledge of how to solve problems in their native language and, therefore, attempting logic problems in a foreign language capitalizes on this prior knowledge. The linking of new information to previous knowledge has long been believed to be an important principle of effective teaching. This connection not only eases the learner's cognitive entry to the activity, it makes the language and meaning conveyed the ultimate focus for the learner instead of diverting it to the mechanics of completing the activity itself.

Finally, Danesi (1979) suggests that introducing puzzles may also serve as a needed change of pace to the daily routine of teaching techniques and can perhaps serve to increase student motivation as a result. Clearly it is to the learner's advantage to be exposed to a variety of classroom techniques so that interest is maintained. In a more recent article Raizen (1999) corroborates this notion and offers further justification for the use of logic problems in foreign language education by concluding, "Logic puzzles should be explored and utilized as a valuable enrichment tool that allows language teachers to add color to their class activities and create mental exercises, thus providing challenge and entertainment at the same time" (p.

45). Though the body of literature on the topic of logic puzzles for language teaching is rather limited, the reasoning presented does serve to legitimize their use as a potentially effective classroom technique.

A 1994 article by Danesi and Mollica sheds more light on the value of games and puzzles in language learning by surveying the experimental results on the topic from the limited academic literature at the time. Danesi and Mollica (1994, p. 13) found that the body of evidence surveyed had “generally shown such techniques to be supportive of language learning processes.” Danesi and Mollica further expound upon the virtues of employing logic puzzles for language teaching by noting three consistent benefits exposed in their survey of the research: cognitive involvement by the learner with the logic puzzle and its context, enhanced learner focus on meaning and creative deduction of the content, and learner assimilation of the meaning-to-form relations used in the puzzle. Although there clearly remains a need for more substantial research on the effectiveness of logic puzzles for language teaching to be done, it is evident that there are several convincing reasons why logic puzzles should be considered as viable language learning activities.

One of the most promising reasons to use logic puzzles in language teaching concerns the potential opportunities they afford for promoting vocabulary acquisition. Logic puzzles provide unique classroom occasions for short, meaning-centered exposure to language in context with the key benefit of encouraging mental engagement with the vocabulary critically important to solving the puzzle. Most research on the current best practices for fostering vocabulary acquisition is in general agreement that this mental engagement with vocabulary, often referred to in the literature as ‘a deep level of processing’ or simply ‘deep processing’, is crucial for unknown words to become known (Laufer, 2001). Schmitt’s (2000, p. 12) succinct description of this notion that “the more one engages with a word (deep processing), the more likely the word will be remembered for later use” seems to speak directly to the strengths of using logic puzzles. As logic puzzles are essentially comprehension and logical deduction tasks on the part of the reader, they inherently work to foster a deep level of mental

engagement with the key vocabulary presented and compel the learner to manipulate these words in the attempt to reach the solutions.

The fact that logic puzzles are generally designed to be solved in relatively short periods of time further underscores their potential value as an effective vocabulary teaching technique. Schmitt (2000) concisely sums up the general agreement in the field that “shorter practice periods are more effective than one longer period” (p. 18). Furthermore, the limited scope of the contextualized scenarios and clues of each logic puzzle provides a unique opportunity to quickly induce repeated exposure to new vocabulary while maintaining learner interest in the material which otherwise may be seen as repetitive (Raizen, 1999). Moreover, as learners are primarily focused on the task of solving the puzzle, the introduction of new vocabulary can be done in a way that is both largely incidental on the part of the learner, yet relatively controlled by the teacher who selects, modifies or constructs a logic puzzle with exposure to particular words as an objective. At the same time logic puzzles can just as easily serve to review or reinforce vocabulary to which the students already have some exposure but have not yet functionally acquired.

The nature of logic puzzles as self-contained tasks particularly well-suited for classroom use under designated time limits also requires learners to make sense of the information quickly without relying on the use of bilingual dictionaries. This additional attribute of logic puzzles works to foster the skills of making inferences and guessing vocabulary meaning from the contextual clues alone. Both of these skills are certainly worthy of practice and encouragement as they are in many ways consistent with the realistic conditions that learners may find themselves in when attempting to functionally use the foreign language. These skills are also of great potential value to those learners hoping to improve their abilities on standardized tests of English for academic or professional purposes and in other instances when the use of bilingual dictionaries is forbidden or impractical.



### **3. Using Logic Puzzles in Class**

Logic puzzles can be most readily employed as timed, in-class activities to generate exposure to vocabulary associated with specific contexts and to test general reading comprehension skills. A more robust sample logic puzzle intended for a beginner-to-low-intermediate level university EFL class, “Problems in Class”, is included in the Appendix and represents what an actual logic puzzle intended for in-class use might look like. As noted previously, the pedagogical objectives of using a logic puzzle as a classroom task are twofold: to generate exposure to certain vocabulary in context, in this case, words and phrases associated with classroom English, and to provide focused reading comprehension practice with a clear, attainable goal, the correct solution of the puzzle.

While the sample logic puzzle alone may indeed meet its stated objectives when used in class, other more optimistic objectives can be met through any number of potential expansion activities designed to reinforce the vocabulary introduced passively through the basic logic puzzle if so desired. Two such activities are included in the “Problems in Class” example logic puzzle seen in the Appendix. The first expansion activity serves as a simple vocabulary log of the new words and phrases noticed in this puzzle by the reader. A second possible activity shifts the objective from a more passive exposure and awareness of the key vocabulary to an active demand for its attempted use in conversation. The sample logic puzzle and expansion activities serve to highlight the adaptable nature of their use in class. Indeed, it seems that logic puzzles can be adapted to almost any context and associated vocabulary, as well as level of difficulty. Additionally, variations of the task beyond simple reading-based puzzles may include knowledge-gap communicative puzzles, in which the scenarios or clues are divided between students, as well as student-production of their own, original logic puzzles for their classmates and teacher to attempt. There is a seemingly endless array of possible effective uses of logic puzzles in class.

#### 4. Student Reaction to Logic Puzzles

Merely justifying logic puzzles as pedagogically sound does not necessarily mean that they are seen as worthwhile by students. Since one intended benefit of the use of logic puzzles is that they be seen as enjoyable, it is necessary to ensure that such a task is well-received by the particular audience of students. In order to gauge students' reactions to the use of logic puzzles at a major university in Japan, course evaluation surveys were completed by 43 second-year students who had attempted logic puzzles in their required English reading classes on a weekly basis over the course of two semesters in 2006. The responses to the survey reveal that a majority of the students held an extremely favorable view toward the use of logic puzzles, rating them the highest of all course activities. The students also rated the opportunity to construct an original logic puzzle positively. Additionally, 67% of the students indicated that they felt that logic puzzles helped to teach them new vocabulary words. It seems safe to conclude that logic puzzles were a welcomed and worthwhile addition to this particular course.

#### 5. Sources for Logic Puzzles

While logic puzzles are not overly difficult to construct once familiar with the basic design, numerous sources for logic puzzles are available both in print and on the Internet. The following list includes some Web sites with logic puzzles freely available for educational use:

*Judy's Logic Problems*

<http://pages.prodigy.net/spencejk/yearlylps.html>

*The Logic Zone*

<http://myweb.tiscali.co.uk/thelogiczone/>

*Puzzles.com*

<http://www.puzzles.com/Projects/LogicProblems.html>

*Who owns the fish?*

<http://www.atkielski.com/inlink.php?ESLPublic/>

Performing an Internet search for “logic puzzles” or “logic problems” will yield significantly more results. It is important to note, though, that most logic puzzles on the Internet are intended for native speakers and will most likely warrant some revision before being practical for classroom use.

## **6. Conclusion**

Although logic puzzles do not represent a revolutionary approach to language teaching and learning, they can serve as worthwhile classroom tasks which keep the learner’s focus centered on making workable sense of the vocabulary used in a specific context in order to quickly deduce the solution. As a result of this mental focus on completing the task, it is believed that learners are able to achieve a sustained mental engagement with the vocabulary presented throughout a short period of time while utilizing contextual inferences to make rational guesses about the meanings of unknown words, thereby possibly enhancing the learners’ chances of acquiring vocabulary. Though further in-depth studies are clearly needed before any firm conclusions about the effectiveness of logic puzzles as a language and vocabulary teaching technique can be made, the numerous potential benefits outlined in this article suggest that they are worthy of continued consideration in the field of applied linguistics. Indeed, the notion that logic puzzles may also serve as a fun, occasional change of pace in classroom tasks for certain groups of students who enjoy a mental challenge while working with logical deduction in a foreign language seems to be enough to justify their continued use in class for the time being.

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### Appendix: Sample Logic Puzzle

#### *Problems in Class*

Megumi, Shinji, Takeo and Yoko are all students in 4<sup>th</sup> period English class at the School of Science and Technology. Each of them has a different specialized course of study (Biology, Chemistry, Computer Science, and Physics). Just as today's class was about to start, each student came to the teacher with a problem. One student had to go to the bathroom, another student left his book under his desk yesterday, one student's computer won't turn on, and another student is going to miss class tomorrow. From the clues, determine each student's name, major, and problem.

1. The student who is going to be absent tomorrow was already late for class 3 times this semester.
2. Shinji, Takeo and the girl who studies Chemistry always come to class on time.
3. The boy who majors in Computer Science never has computer trouble, but Yoko always does.
4. Shinji isn't interested in computers and never forgets his things in class.
5. The student who studies Physics does not need to use the restroom.

Student Name	Major	Problem
Megumi (F)		
Shinji (M)		
Takeo (M)		
Yoko (F)		

A grid may be helpful to clarify the information presented in the clues.

	Biology	Chemistry	Computer Science	Physics	Needs to use bathroom	Left textbook in class	Computer won't turn on	Will be absent tomorrow
Megumi (F)								
Shinji (M)								
Takeo (M)								
Yoko (F)								
Needs to use bathroom								
Left textbook in class								
Computer won't turn on								
Will be absent tomorrow								

### Vocabulary Spotlight

What are some new vocabulary words or phrases presented in this logic puzzle? Can you guess the meaning of these words? Try to list at least five words or phrases and a basic definition to help you remember them.

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### Expansion Conversation

Now that we have figured out the student's problems, how would each student explain his/her problem to the teacher? Take turns with your partner practicing a conversation between one of the students and the teacher.

**Sample Logic Puzzle Solution**  
*Problems in Class*

Student Name	Major	Problem
Megumi (F)	Physics	Will be absent tomorrow
Shinji (M)	Biology	Needs to use the bathroom
Takeo (M)	Computer Science	Left textbook in class
Yoko (F)	Chemistry	Computer won't turn on

	Biology	Chemistry	Computer Science	Physics	Needs to use bathroom	Left textbook in class	Computer won't turn on	Will be absent tomorrow
Megumi (F)	X	X	X	O	X	X	X	O
Shinji (M)	O	X	X	X	O	X	X	X
Takeo (M)	X	X	O	X	X	O	X	X
Yoko (F)	X	O	X	X	X	X	O	X
Needs to use bathroom	O	X	X	X				
Left textbook in class	X	X	O	X				
Computer won't turn on	X	O	X	X				
Will be absent tomorrow	X	X	X	O				

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