

May 2010

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Recommended Citation

Fukada, Atsushi (2010) "Teaching Technical Reading with Technology," *Global Business Languages*: Vol. 4 , Article 3.
Available at: <http://docs.lib.purdue.edu/gbl/vol4/iss1/3>

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TEACHING TECHNICAL READING WITH TECHNOLOGY

INTRODUCTION

The purpose of this article is to discuss some issues in teaching technical reading and present a CALL (Computer-Assisted Language Learning) system that aids such teaching, especially its design philosophy. Although this CALL system was developed for teaching technical Japanese, it is hoped that most, if not all, pedagogical and design issues are equally applicable to other languages.

As the mastery of a foreign language reaches the point where one can engage in study and research in technical areas (e.g. engineering and business) in that language, one skill that becomes particularly important is reading. It is beginning to be recognized that the *de facto* international language, English, is not always sufficient. For instance, in some areas of technology, Japan may possess the most advanced knowledge and technology. Naturally, the latest reports, technical documents, patents, etc. come out in Japanese first. So, in order for Americans (or whomever) to compete with them, the ability to understand, in this case, technical Japanese becomes crucial. In response to such needs, the present author and his colleagues conducted a research and development project the purpose of which was to find an effective instructional method for teaching reading in technical areas and to develop materials for it.¹ One of the results of the project was a software system called CATERs (Computer-Assisted TEchnical Reading System).² The present article will discuss

¹ "Development of effective teaching materials and methods for the purpose of building the reading skills in Scientific and Technical Japanese," Science Research Grant (Ministry of Education, Japan) with Chieko Kano as the principal investigator (Project No. 03044026). 17 researchers participated in the project from 1990 to 1992.

² The system designers of the CATERs delivery system were Atsushi Fukada, Kazumi Hatasa, Chieko Kano, and Hilofumi Yamamoto, and the software development was mainly carried out by Atsushi Fukada. The authoring system was designed and coded by Atsushi Fukada.

the design philosophy behind the system in relation to various issues in reading instruction, in addition to a fairly detailed description of the system itself.

ISSUES IN TECHNICAL READING INSTRUCTION

Issues in technical reading instruction to be dealt with below may be more general than just about reading, but for the purpose of the present discussion, they will be taken up as reading issues.

The first issue is that the language teachers' lack of technical knowledge sometimes makes it impossible for them to teach effectively. For example, to a person without knowledge of electrical (computer) engineering, it is difficult to judge whether the phrase *of the CPU* in the noun phrase *the number of transistors and the clock speed of the CPU* is attached to *the clock speed* alone or to *the number of transistors* as well. Since the interpretation of such a simple phrase already raises a problem like this, it is not difficult to appreciate the magnitude of the difficulty an average language instructor would have to face in dealing with a whole passage or article. One strategy might be for language teachers to study one or more technical fields. This would be useful in a homogeneous situation where all the class members study the same field, e.g. a business language course in a business school, but not practical if there are students in the same course representing a variety of fields. This problem of interpretation may be thought of as a unique property of technical language, but in actuality, the same problem surfaces when a teacher deals with reading material written about a topic unfamiliar to the teacher. It is true that in technical discourse the magnitude of the problem is so much larger, but it ought to be noted, nonetheless, that the difference is a quantitative rather than qualitative one.

A second issue has to do with teaching materials. It is problematic to use the same set of materials for a class consisting of students from a variety of disciplines. When we talk about different disciplines, it is sometimes difficult to know how finely to make distinctions. For instance, chemical engineering and mechanical engineering may be different enough to be treated as different fields for the purpose of technical language instruction. In order to accommodate students from these two fields, a teacher would probably have to lower the level of technicality to an introductory engineering level and defeat the purpose of technical reading. As is clear from the experiment reported in Taniguchi (1991a),

one prominent characteristic of technical reading is strong reliance on the strategy to make use of content schemata (background knowledge) when comprehending a passage. Therefore, sacrificing the technical aspect would be like denying technical language instruction altogether. Even from the standpoint of general reading instruction, it would be not only painful for learners to read something they have no interest in (i.e. a case where a learner reads a document in another field), but also discouraging because they would not understand the content even if they knew all the language elements involved.

As a third issue, there are learners who are not taking language courses any more, but are nonetheless interested in continuing training in technical reading somehow. Such learners are typically so busy with studies and research in their technical areas that they would not have time to attend a technical language course even if one were to be offered. Also, because technical language courses are still relatively rare, they are often geographically inaccessible to such continuing learners.

Finally, I would like to touch upon the issue of team-teaching involving a content area specialist and a language teacher. At first glance, it seems ideal, but there may be operational difficulties. It is to be expected that language teachers and content specialists totally differ in not only specializations, but also ways of thinking, and awareness of issues in technical language teaching. For them to work effectively together, then, may not be as easy as it appears. Furthermore, there may be institutions that do not allow team-teaching or an instructor in one department to teach in another. When it comes to teaching materials and methods in a team-teaching situation, virtually nothing is well established for newcomers to use. One possible exception to this is business language, for which a number of textbooks and other materials have existed for many languages. It is not clear, however, whether the level of technicality these materials address is equivalent to that which we have been discussing thus far.

READING INSTRUCTION

In this section, we will consider what form reading instruction should take, while examining what has typically been done under the name of reading instruction.

As Fukada, Kobayashi, and Deguchi (1990) point out, Been's (1975) distinction between *language-oriented reading* and *content-oriented*

reading is useful in discussing reading instruction in foreign language education. Language-oriented reading refers to a kind of “reading” activity where the purpose of reading is not so much the comprehension of the content as the vocabulary and grammar items embedded in the reading passage. As long as teachers are using reading passages as a way of introducing new vocabulary and grammar items, they are, strictly speaking, not teaching reading, but teaching vocabulary and grammar. Of course, linguistic knowledge (like vocabulary and grammar) is a prerequisite to reading to some extent, but the same is true of other skills. It is, therefore, useful to separate the teaching of vocabulary and grammar, on the one hand, and that of reading, on the other.

As opposed to language-oriented reading, content-oriented reading refers to an activity where learners deal with reading passages with some communicative purpose. Content-related activities that have been done in reading classes include paraphrasing, translating, and comprehension questions. These activities, however, are designed to verify the learners’ understanding of the written content but do not teach how to read. In such reading classes, the very act of reading, in most cases, gets done before the class without the teacher’s intervention, guidance, or advice.

Then what would constitute the teaching of reading? Recent second language reading instruction research suggests (content-oriented) extensive reading and reading strategy training. Fukada, Kobayashi, and Deguchi (1990) discuss the former with respect to Japanese. The latter, falling under the notion of metacognition, has a large body of theoretical literature. See Kimura, Masuhara, Fukada, and Takeuchi (1993) and Masuhara, Kimura, Fukada, and Takeuchi (1996) for discussions with respect to ESL/EFL and Taniguchi (1991b) with respect to Japanese.

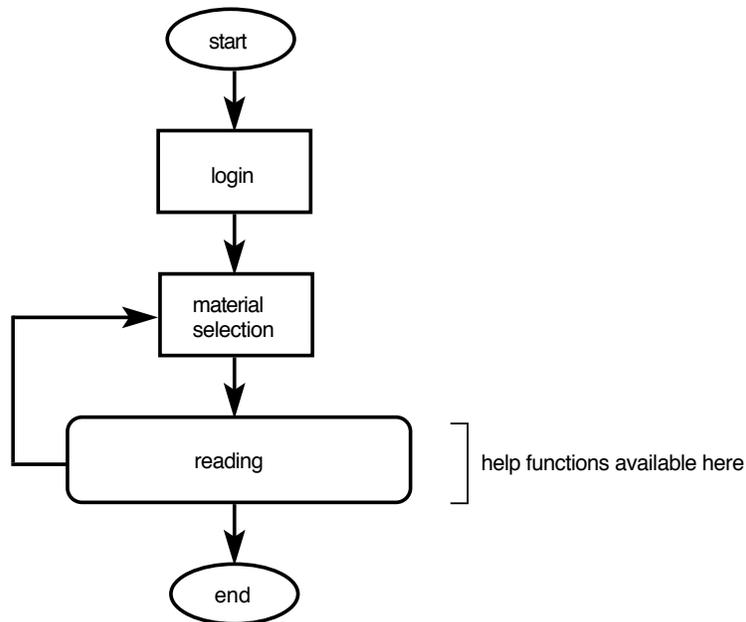
In strategy training, it is not necessary to use technical writings as materials unless strategies like making inferences on the basis of content schemata are involved. Materials that do not present challenges in vocabulary and grammar ought to be selected in order for the learners to concentrate on strategy training. Furthermore, strategy training can be effectively given as a whole class activity, with no compelling reason to use technology. For these reasons, the developers of CATERS decided to exclude strategy training and designed a system that provides a learning environment that facilitates (content-oriented) extensive reading of technical materials.

OVERVIEW OF CATERS

The CATERS System is, in a nutshell, an electronic reading laboratory system. It consists of two components: the delivery system and the authoring system. The former interacts with learners, presents reading materials, and provides assistance as requested. The latter interacts with instructors and material authors and facilitates the creation of CATERS reading modules to be delivered via the delivery system. The current version of the system runs on the Macintosh computer with a color display.

THE DELIVERY SYSTEM

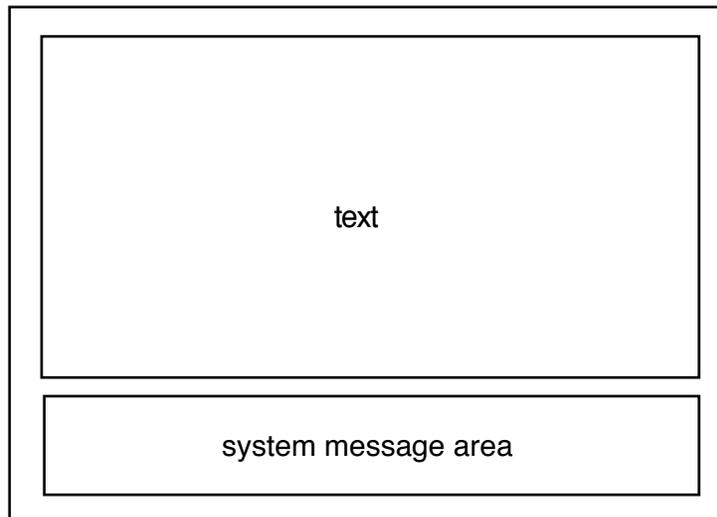
The delivery system itself has a rather simple design. It first asks the students to select a reading passage to work on. It then displays the reading passage and does nothing after this point unless the users give instructions. The following diagram shows the flow of the system.



The system is equipped with a set of functions for facilitating reading that the users can call up at any time. The goal of the students, then, is to understand the passage with as few calls to the functions as possible. The functions, which provide help with both top-down and bottom-up text

processing, are described below. Note that instructors using the authoring system have complete control over what functions to make available for each reading passage.

The following window represents what the learner sees in the reading mode. The system message area is reserved for displaying translations and other system-generated messages.

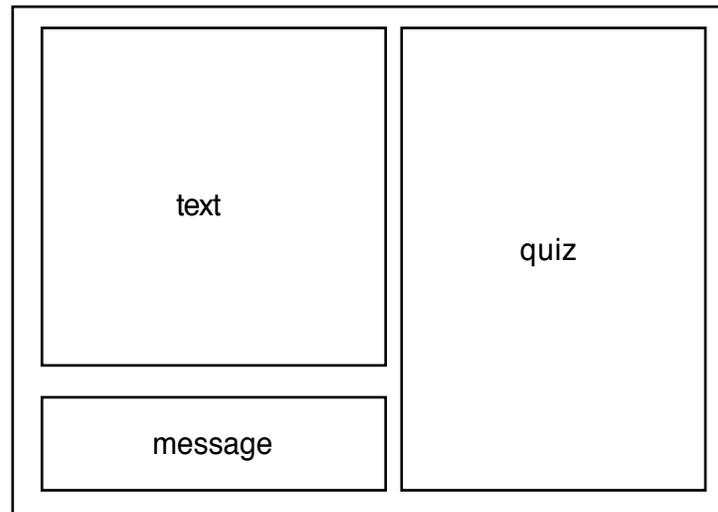


Timed Reading

This function measures the learner's reading speed, which serves two purposes. First, the learners can time their reading speed to see their progress. Second, it encourages a more natural mode of reading employed by native readers, keeping them from falling into the trap of reading one word at a time.

Global Quiz

This function presents a series of content questions pertaining to the main points of the passage. The students can check their understanding of the whole passage by taking this quiz. Since this is not a test, they can choose to look at the correct answers at any time. Quiz questions are presented on the left-hand side of the window as shown below.



Paragraph Quiz

This function presents questions pertaining to a particular paragraph the student wants to work on. Content as well as grammar/vocabulary questions can be presented here.

Kanji Dictionary Search

This function presents information on a particular kanji character upon the student's request, and as such, it is a Japanese-specific function. The information includes reading(s), meaning(s) and the stroke count.

Kanji Reading

This function shows the reading of a particular kanji character as it is pronounced in the particular context of the text. This is also a Japanese-specific function.

Display Sentence Skeleton

This function displays in three different colors the skeleton (basic) structure of a particular sentence the student selects. If we take the previous sentence as an example, *This function* would be in blue (subject), *displays* in red, and *the skeleton (basic) structure* in green (object). When the subject or the predicate is suppressed, for example, a comment to that effect can be displayed in the message area. In fact, in the authoring

phase, the author can input any comment to be displayed with the skeleton display.

Phrase Translation

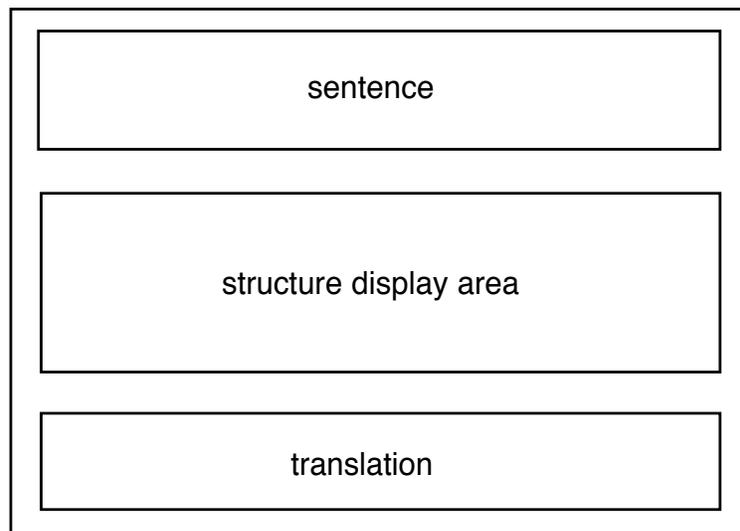
This function provides a translation of a phrase the students select. If they select one or more phrases, a translation will be presented for each of the phrases.

Sentence Translation

This function provides a translation of a sentence the student selects.

Display Structure

This function provides an interactive display of the structure of a sentence of the student's choosing. The student can examine the details of the sentence structure along with English translations. This function uses its own window, which is organized as follows.



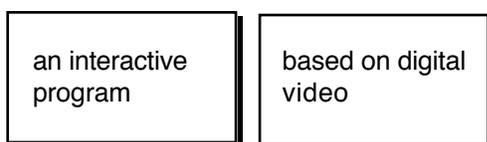
The sentence area displays the selected sentence and the whole sentence is highlighted initially. If we take *Purdue's TELL Center developed an interactive program based on digital video* as an example, the structure display area would display the first breakdown of the sentence initially as follows.



A shaded box indicates that the constituent in it is further analyzable, while a box without shading contains a word or phrase that cannot be analyzed further. If learners decide to examine the inner structure of the phrase *an interactive program based on digital video*, they can click on the box and cause the whole display to change as follows:

The sentence area: *an interactive program based on digital video* becomes highlighted

The structure area: the detail of this phrase is displayed as follows:



The translation area: A translation of *an interactive program based on digital video* is displayed.

In this way, this function interactively displays the structure of a sentence at whatever level is desired by the learner. No complex tree diagram or grammatical term is used in this function. To the best of our knowledge, this is the first serious attempt at displaying grammatical structures in CALL.

Show Reference

This function displays the referent of a referring expression upon the student's request.

Show Scope

When the student selects a head noun and invokes this function, it will display the scope of the preceding modifying materials.

Show Graphics

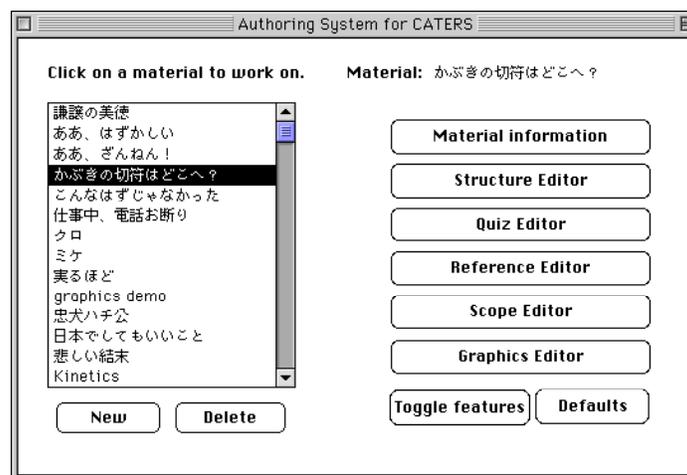
This function displays a graphic image linked to a piece of text in a separate window. There is no limitation on the number of images that can be linked to a passage. For example, a passage might include a sentence like

“Please look at this map.” where the underlined word represents a link to an associated image. The rest of the passage might be a series of directions. Comic strips can be implemented with this function as well.

In addition to these “help” functions, CATERs is also equipped with a facility to record learners’ on-line activities in detail. Every time material is selected or a help function is called, a record is made as to the details of the activity along with the time when it occurred. This facility was designed with three purposes in mind. First, the instructor can utilize these records to monitor their students’ activities. Second, the author can examine the records for the purpose of finding problems with the materials themselves. One can, for example, look at quiz records and perform item analysis on them with a view to improving the questions. Third, these records may be used as data for research into the learners’ reading process.

THE AUTHORING SYSTEM

The authoring system consists of the following components: Materials Information Editor, Quiz Editor, Structure Editor, Scope Editor, Graphics Editor, Reference Editor, and Feature Control Panel (“Toggle features” in the figure below).



These components do not require technical computer knowledge to operate. The following is a brief description of each.

Materials Information Editor

This component allows the instructor to input for each text the title, author(s), copyright holder(s), genre, length, level, and field. The field is designed to contain a technical area. If it is not technical, it can simply say “general”.

Quiz Editor

This component allows the instructor to input Global Quiz as well as Paragraph Quiz questions. The following four question formats are available: multiple-choice, short answer (from one to just a few words), highlight text, and self-judging. The highlight text format poses a question and allows the user to answer by highlighting a portion of the reading passage. The self-judging format poses a question and lets the user formulate an answer mentally and check it against the correct answer. This format is useful for questions whose answers take the form of a short free-form essay (which the computer is not yet capable of understanding and judging).

Structure Editor

This component allows the instructor to input four types of information for each sentence in the passage: the skeleton structure, detailed structure, translations at all levels (from word to whole sentence), readings of kanji characters if any. Obviously, this is the most time-consuming part of the authoring process. The program has been carefully designed to minimize the work of the operator. The data entered using this program is utilized by the following functions: Kanji Reading, Display Sentence Skeleton, Phrase Translation, Sentence Translation, Display Structure, and Show Scope.

Scope Editor

Since inputting structure data takes a great deal of time and effort, authors might elect to disregard them occasionally (e.g. when the structures involved are too easy or not important). When this happens, all the functions that depend on structure data will still function with the exception of Show Scope. The Scope Editor is to be used specifically under these circumstances to input scope data manually. It allows the author to specify words and their scopes one pair at a time. When structure data are available, scope information is derived algorithmically.

Graphics Editor

This sub-program allows the author to establish links between graphic images and particular pieces of text in the passage. It does *not* allow editing of graphic images. Graphics, therefore, must be created with another application and saved in PICT format to be imported into the authoring program.

Reference Editor

This component allows the instructor to specify referring expressions in the passage and input their referents. The data entered using this program is utilized by the Show Reference function.

Feature Control Panel

As mentioned above, all CATERS features can be turned on or off by the material author or instructor on a per material basis. Some may prefer to turn off the translation functions for certain materials.

DESIGN PHILOSOPHY

Now that an overview of the system has been given, we can discuss the instructional methodology adopted in CATERS and design points that we paid particular attention to.

Strictly speaking, this system, as mentioned above, does not teach how to read *per se*, but is intended to provide an environment that facilitates the learning activity that we believe will enhance the learner's reading competence. Thus, we are by no means claiming that displaying things like translations and sentence structures will have direct impact on the learner's reading ability. There may be a more direct way to teach reading, but no such method has been discovered so far.

By "the learning activity that will enhance the learner's reading competence" we mean an activity where the learner tries to understand the intended meaning that the writer is trying to convey through his writing (i.e. content-oriented reading). On this view, as stated above, vocabulary and grammar learning is not a reading activity *per se*. In fact, looking up words in a dictionary or grammar points in a reference grammar book as one reads would seriously disrupt the reading comprehension process. (The same is true of a reading class session. Lecturing on grammar points in such a way as to interrupt the learners' reading process would be counter-productive.) However, as a matter of practicality, there is no de-

nying that unknown vocabulary and grammar constructions are impediments to the learner's comprehension. CATERS's functions of displaying translations and structures instantaneously allow the learner to continue the reading comprehension process with as few interruptions as possible (and if they do occur, keep them as short as possible) caused by unknown language elements.

It should also be pointed out that the system is designed with the following three learning situations in mind. One is a situation where course materials are also available as CATERS reading modules. In this case, students can use the system for their preview and review. Since CATERS is capable of displaying translations and detailed structures, the instructor could leave detailed linguistic study of the text to an individual lab session and use the class time primarily for content-related activities. Another situation is where CATERS reading modules are used as supplements to course materials. The instructor may not necessarily go over these materials in class, but he/she is presumably available for help. The last situation is where CATERS is strictly for self-study and there is no language specialist around. CATERS, thus, addresses the problem of continuing learners. The system could be appropriately used in a distance learning situation as well. The ability to provide assistance at this level is a strength of CALL.

With respect to cooperation between language specialists and content area experts in relevant fields, developing CATERS reading modules would be one possible area of collaborative effort. The content area expert would be especially useful in selecting passages, translating them, and creating comprehension questions. The end result would be something that neither the language specialist nor the content area expert could have created alone. Armed with such computerized modules, language instructors would be able to focus on reading strategy training and other beneficial activities without being bogged down by interpretations of nit-picking details like an interpretation of *the number of transistors and the clock speed of the CPU* discussed above.

Another potential benefit of CATERS has to do with the selection of material for a technical reading course with students of diverse backgrounds. As the number of reading selections for various content areas increases, class reading becomes a less important question. The students will be able to select on their own or with the instructor's advice passages around the level that interest them. Reading is an individual activ-

ity, so it makes sense for reading practice to be individualized also. A guided individualized extensive reading program of this kind has long been recognized as extremely effective, and it would certainly be appropriate in a technical reading course.

CONCLUDING REMARKS

The CATERS delivery system is available for free download provided that it is to be used for non-commercial purposes. The URL of CATERS's home page is <<http://www.sla.purdue.edu/fl/JapanProj/CATERS>>.

In 1997 and 1998, the present author and two colleagues developed a set of CATERS Japanese reading modules under a CIC grant.³ This set contains 26 general (non-technical) reading passages and is available to the general public for non-commercial use. The URL of a report on this project is <<http://www.sla.purdue.edu/fl/JapanProj/CIC-JAPIR/>>.

CATERS has been field-tested at MIT's summer technical Japanese program. A system evaluation based on the field test is reported in Yamamoto, Fukada, Kano, and Hatasa (1993).

The CATERS authoring system can also be made available to potential authors (e.g. language teachers, materials writers, etc.) provided that they agree to the following conditions:

- potential authors must be Japanese language professionals,
- they must have access to the Internet in general, e-mail and the web, in particular,
- they will use authored materials for educational purposes,
- they will share with others the materials developed,
- they will NOT give out a copy of the authoring program to anyone without authorization, or put the program in a public place.

To apply for a copy, one can contact the present author at <afkada@purdue.edu>. As discussed earlier, CATERS will become more and more useful as the number of its available reading modules grows. Our plan is to have as many people involved in authoring as possible to expand the library of materials.

³ CIC, or the Committee on Institutional Cooperation, is a consortium consisting of twelve universities in the Midwest region.

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