An evaluation of independent learning of the Japanese hiragana system using an interactive CD

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Abstract

As Japanese uses three writing systems (hiragana, katakana, and the ideograms known as kanji), and as materials in the target language include all three, it is a major challenge to learn to read and write quickly. This paper focuses on interactive multi-media methods of teaching Japanese reading which foster learner autonomy.

As little has been published on interactive multi-media methods of teaching Japanese reading, it seems likely that traditional resources are generally used for this activity. The courseware includes sound files showing the pronunciation of each *kana* as well as simultaneous animation showing how to write each character. This paper investigates whether interactive courseware, used independently of classroom interaction, results in measurably greater recognition of the hiragana syllabary than more traditional methods. After briefly situating the study in the context of research on the teaching of Japanese reading and learner autonomy, the paper will present the courseware as well as an empirical study comparing the results of the use of the courseware by learners at beginners' level: one group using the courseware, and the other using paper-based materials. This is followed by an account of learner diaries written by zero-beginner level learners of Japanese using the courseware.

The study indicates that acquisition of a recognition-level knowledge of hiragana is approximately twice as fast using the courseware as using paper-based materials. Learners also learned to write the hiragana without explicit instruction.

Keywords: Hiragana, multimedia courseware, Flash, blended learning, interactive materials, learner autonomy

1 The Japanese writing system

The writing system is one of the great challenges in learning and teaching Japanese. This paper will describe a CALL adaptation of a colour-based method of teaching one of the Japanese syllabaries as well as the results of a study comparing learning using computer-based materials to learning using paper-based materials.

Japanese has three writing systems: two phonetic syllabaries, hiragana and katakana, and the logographic system imported from China, kanji. In general, the rounder hiragana are used to write inflections as well as words that cannot be written

in kanji, while the squarer katakana are used to write loan words and, at times, scientific terms.

Given the challenges implied by learning the three character sets, some materials writers have avoided Japanese character sets altogether and opted to use Roman characters to teach Japanese. Though this would seem to have the virtue of allowing immediate use of speaking and listening skills, it is not a solution. Its disadvantages, in addition to the very real one of depriving learners of access to authentic materials, include making understanding Japanese grammar considerably more difficult and, of course, condemning learners to distressing illiteracy when they do go to Japan. Kamiyama (1973: 48) calls teaching all but strictly conversational Japanese using Roman characters "a waste of time" and it is hard to disagree with her. There is little research available either in English or Japanese on the acquisition of the basic skill of decoding hiragana by zero beginner learners of Japanese as a Foreign or Second Language. What research is available indicates that the use of Roman characters to teach the pronunciation of the hiragana and katakana syllabaries is still common.

2 Teaching Japanese scripts

In the words of P.G. O'Neill (1967): "The Japanese kana signs are so basic and elementary a part of Japanese writing that the problem they can pose for the beginner is often overlooked." While this is no longer true in terms of the quantity of hiragana workbooks and websites available, in terms of content, there are currently three main methods of learning the kana evident in both paper and web-based materials: romanisation, picture-based mnemonics and web-based materials that depend on elements of both.

2.1 Romanisation

The syllabets are romanised for learners to approximate the pronunciation. Traditionally, learners were given a chart with romanised equivalents of the pronunciation of the kana and memorized it. Many recently-produced materials still use romanised readings of the characters being taught. Machiko Tsujimura's account of using two types of game in teaching hiragana shows how the card and dice-based games provided good reinforcement of the hiragana introduced earlier (Tsujimura, 1995: 156), but the pronunciation of the characters is still based on romanisation (*op. cit.*: 151). Noriko Hasegawa's account of a short introductory hiragana course details reinforcement using flashcards and drills, but since the first session begins with a review of roman characters (Hasegawa, 2005: 5), it seems safe to assume that romanised equivalents were used to teach pronunciation. Activities used for review are a bingo game with hiragana instead of numbers and a Japanese equivalent of the card game "old maid" where learners paired hiragana with romanised equivalents.

2.2 Visual mnemonics

A method popular since the late 1980s uses visual mnemonics based on the shape and sound of the characters. With this method, a picture based on the shape of the character being studied prompts an auditory cue similar to the pronunciation

of the character. One of the best known of these is the set of mnemonic cards by Quackenbush and Ohso (1989) (see research paper Quackenbush *et al.*, 1989). Some success has been reported with this method (Thompson & Wakefield, 1996), but so have mixed results: Hatasa (1991) reports a successful CALL adaptation of the method which still depends on romanisation. However, research cited by Ruddock (2000), shows that mnemonic devices devised by the learners themselves rather than use of those supplied by others, can have more positive results.

2.3 *More recent methods*

There is now a large number of web pages offering hiragana lessons or practice of hiragana, katakana and kanji. Many of them use romanisation in teaching the pronunciation of the characters or in testing; though some sites have sound files showing pronunciation, or animation showing how the characters are written, few sites combine both. Those demonstrating how to write the character often show how it is pronounced with romanised equivalents; and many sites with sound files giving pronunciation lack the animated features that show how the hiragana are written. Where both are provided, the audio file often opens in a separate window or the download speed of sound files on the internet can be frustratingly slow.

2.3.1 Coloured cards. In an attempt to avoid using roman characters in introducing the pronunciation of hiragana, and also to make use of a greater variety of learning styles among learners, teachers of Japanese at the University of Limerick have, since 2000, been using a method of teaching the hiragana inspired by the Silent Way's use of colour (Gattegno, 1978). Thinking that the use of cards rather than charts or fidels would allow for a greater range of learner-centred activities in class, as well as activating a greater number of learning styles, we made and began to use A4 sized cards with colour on one side and the hiragana on the other. This allows us to introduce the shapes and sounds of the hiragana and the order of the hiragana chart, which are important to know for making sense of grammatical inflections later as well as for dictionary use, to zero beginners at the start of their study of Japanese.

The cards are A4 sized, with colour on one side and the character written in black on the other. The side with the character also has the colour or colours on the back of the card repeated in miniature at the top left-hand corner. The cards for vowel sounds in the first line of the table – (a), (i), (u), (e), (o) – have single colours on the back: blue, white, green, yellow and red in that order. The first character in the second line, (ka), has orange to represent the "k" sound of the syllabet and blue to represent the "a" sound. The card for the next syllabet in the table, (ki), is coloured orange and white, and so on.

The introduction to the sounds and structure of the hiragana chart in class has been combined with pair, group and whole-class activities both in and outside class, including an audio CD and workbook developed at the University of Limerick, which gives extra recognition and writing practice in hiragana, and later in katakana. Between ten and fifteen hours' class time has been needed to cover introduction, review and practice, while learners do review and practice outside class time also.

Surveys of learners over the past six years have shown that this method works well for the majority of learners.
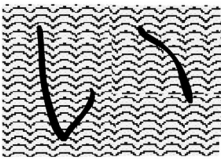
The advantages of the colour card method have been that it confronts one of the perceived difficulties of learning Japanese immediately by introducing one of the character sets on the first day of class. It allows learners to interact with and manipulate the cards in a variety of learner-centred activities; and learners experience success quickly. It also encourages the use of the target language from the first class and enables the teaching of Japanese script without recourse to Roman script, leading to better pronunciation. Oral tests at the end of the first semester with students who used this method showed closer to native speaker pronunciation, particularly of the "r" sounds, among learners who had used the coloured cards compared to a minority of learners in the group who had used romanisation to learn to read hiragana.

An obvious disadvantage of the colour cards was the fact that learners had to be in the classroom to use the method since they did not have their own copy of the cards (though at least one learner made her own copy of the cards for personal use). Another difficulty was that in the initial stages at least, much of the input came from the teacher, so that while we aspired to promoting learner autonomy, the method as we had come to use it was unacceptably teacher-centred.

2.3.2 Problems associated with the cards. The possibility of colour-blindness in learners is a more serious potential difficulty with this method. Statistics vary, but up to eight percent of men and 0.4 percent of women have some difficulty distinguishing colours. The most frequent problem is displacement of green and red, though perception of other colours can be affected (University of Illinois, 2007). To compensate for these difficulties, redundant coding was used in the electronic version of the cards, for example, thicker lines and bigger symbols, or lines with different shapes or patterns, all of which make it easier to distinguish colours in spite of difficulties in perceiving colour.

Whole class activities can give rise to an over-competitive group dynamic, or learners who find the speed of the class too fast can feel isolated or frustrated. Giving

Screenshot 1: Table with one character adapted for colour blindness.

feedback in class can also have affective implications as learners at the very beginning of the learning process can experience language anxiety as a result of classroom activities or instructor-learner interaction (Oxford, 1999). Giving learners a means of independent learning outside class should avoid these problems.

3 The courseware

The cards worked quite successfully as learning objects in that they "may be used for learning, education or training" (Institute of Electrical & Electronics Engineers, 2002). Making a digital version of the cards seemed a natural progression and the resulting courseware is an effective reusable learning object. Criteria for effective reusable learning objects are the same as for effective learning objectives: they should be specific, measureable, attainable, relevant and targeted to learner needs. The courseware was developed with a specific learner outcome in mind: that learners would learn to read hiragana faster than with the cards, and for *ab initio* learners of Japanese, it is crucial that they learn to read as quickly as possible, and with the minimum use of Roman characters.

It was important to combine as many of these positive features as possible with the advantages of mobile courseware (in this case a CD) so that this new medium would have the following advantages:

1   Encouragement of individual study outside classroom (virtual copy of the coloured cards);
2   Learning on demand (available in the lab, or CD distributed to learners);
3   Demonstration to learners of the stroke order used when writing the hiragana;
4   Sound files which played back instantly;
5   Simultaneous access to the sound and shape of the character;
6   Activities which allowed learners to progress at their own speed and get instant feedback on testing activities;
7   Handwritten rather than printed examples.

The courseware gives learners individual access to the colour association and provides additional features, principally animated writing of characters and sound files, giving pronunciation. Learners initially see a chart: hovering over the chart with the mouse highlights the colour and displays the character. Clicking on the character opens up a new screen reinforcing the colour associated with that character and a speaker icon prompts learners to open up the sound file. At the same time as the sound file is playing, an animated pencil demonstrates how the hiragana is written. Correct stroke order in writing all of the Japanese character sets is important, and the animation helps to form good habits. When developing multimedia courseware, it is important to remain focussed on learning objectives. Having a specific, even if rather limited, objective with measurable outcomes ensures that courseware design is not compromised by the availability of extra features: in other words "bells and whistles" should not be included.

The courseware includes a revision table as well as an additional table introducing voiced characters and plosives. In the revision table, each sound is only one mouse-click away. The courseware also includes a testing section, with thirty multiple choice
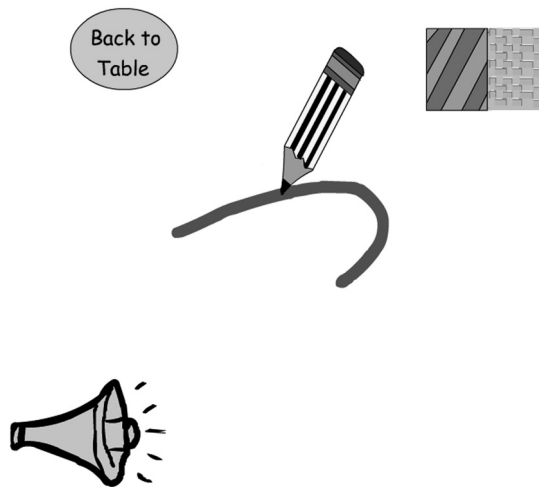
Screenshot 2: Character being "drawn" note the pattern on the colour association.

items covering the whole table. We decided on multiple choice testing as this method can encourage and motivate learners with partial knowledge over those who are simply guessing (Chang *et al.*, 2007). Learners do not take this set of questions "against the clock". In our usability testing we observed that competitive learners took the test before they could have successfully completed the table and they did not need the "motivational effect" attributed to "beat the clock" exercises (Alessi & Trollip, 2001) We felt that including a time restrictive test was unnecessary and might demotivate some learner types.

3.1 Courseware development

A number of considerations needed to be taken into account before choosing the authoring tool to develop the courseware. The main factors were: accessibility, ease of use and quality of visuals. Other technological concerns included browser compatibility and bandwidth speed.

Flash, developed by Macromedia, is a powerful authoring tool that allows the development of e-learning material that can include text, graphics, sound, animation and interactive buttons. Flash also features a scripting language called ActionScript which allows further interactive features. Files that are created in Flash are called "movies" and have a .fla file extension which means that these files can be edited. The published Flash files can be published as .swf files. These are the compressed and final files that are read by the Flash Player. This allows users without the Flash package on their computers to play the files.

Within the Flash environment it is relatively easy to animate and the designer has total control over the animation (size, colour, speed). This finished courseware is highly interactive. On every screen of "How to read Hiragana" users are expected to partake in the learning experience: there is little opportunity for passive learning. The use of simulation in Flash enables learners to view a character being virtually "drawn" over and over again. Flash facilitates audio and video integration without displaying popup

player windows. Many e-Learning programs available on the web are slow to download and feature popup windows. Another advantage of having the program on a CD is that the security settings of individual computers will not block any aspect of the courseware.

Flash facilitates both vector and bitmap animations. Unlike bitmaps, vector graphics when scaled up retain their quality and will not appear "grainy". Vectors also have a much smaller file size than bitmaps. In addition to this the compression technology within Flash makes file sizes small and therefore the .swf files can be downloaded quickly. Flash player is also available to download (free of charge) and therefore anyone can download the player to their own PC and view the files.

3.2 *Usability*

Nielsen (2000) repeatedly stresses that usability testing is a necessary stage of the development process. If there is no testing of courseware before it is made available to learners, there is a much higher chance of critical and negative feedback. Formative evaluation rather than terminal evaluation is very worthwhile as it facilitates improvement before the end product reaches the end user.

We carried out usability testing at a number of stages throughout the development of the courseware. Evaluating the courseware during the development process in this manner allowed potential users to give their comments and provide constructive criticism. Usability testing carried out early in the development process also allowed enough time to implement valid suggestions and eliminate possible problems.

Usability testing followed a task-based approach. This type of usability testing focuses on how typical users perform key tasks. The first group were given the CD and were asked to perform a key task: to familiarise themselves with the Hiragana table. We observed and recorded how the users interacted with the courseware. When the testing period was finished, the users completed a questionnaire for additional feedback. Some of the most common suggestions were implemented. Our second group of usability testers were given the improved version of the courseware, based on the initial testing, allowing us to observe and record the effect of the changes.

3.3 *Instructions*

Clark and Mayer (2003) note that instructions should always be clear and concise. The tone of instructions is crucial and when issuing instructions a conversational style is more effective than a formal one. Below is an example of formal and informal instructions: for instance, a formal instruction would normally read as follows: "This program demonstrates how to write the Hiragana characters. The aim is to learn how to draw…. Examples are provided throughout the program." Conversational instructions, however, would read as follows: "On completion of this course you should be able to….When you click on a character…."

It is also very important to set out the aims and objectives of the courseware so that they are clear and easy to understand. "How to read Hiragana" uses a conversational tone to describe the aims and objectives of the courseware, and this tone appealed to our usability groups. The typeface for the instructions was another significant screen element that needed to be carefully considered. Shriver (1996)

advocates using a san serif style for online/screen delivery. The font used in "How to read Hiragana" is comic sans. The usability groups remarked that they "thought that the instructions were friendly and easy to read".

3.4 Navigation

Navigation is crucial to any e-Learning environment. Users do not want to be trapped or lost at any point during their learning experience. It is therefore vital to include, at the very least, "next" and "previous" buttons for navigation. In an effort to limit the amount of English text used in the courseware, the navigation buttons initially had no text on them. The button that redirected users to the Hiragana table was originally dark red by default and a bright red when the user moved their mouse over it. This created a "lit up" effect when users intentionally moved their mouse over the button.

The group involved in the usability testing all stated that they would prefer to have some text on the buttons. The usability group also commented on the colour of the "Back to Table" button. They remarked that they would prefer a green or blue button. Therefore, we added the text "Back to Table" to the button and changed the colour to a dark blue (default) and bright blue when users moved the mouse over it.

3.5 Learner control

The courseware allows learners to replay animations and to listen to audio as often as needed: this hands control over to learners, as they can access any character at any time. The order in which learners want to approach the Hiragana table is completely left to their own preferences. At any point learners can click the navigation buttons (breadcrumbs) and go back to the main table.

Clark and Mayer (2003) suggest giving learners control, but not too much control. Learners will want control but may not know the best ways to improve their learning. Therefore, instead of letting learners skip over a lesson without taking any kind of quiz or doing some practice, which will show them what they do and do not understand, navigation controls should direct the learners to go through some quiz or practice before they can skip to the next lesson. The hiragana courseware allows users to take a short test. This provides learners with instant feedback and enables them to monitor their own progress. The quiz draws on all 46 characters and all 24 voiced characters. Our group of learners were able to recognise which rows they were weak on as a direct result of taking the test. Where users had problems identifying a character, they were able to exit the test, go to the table and then retake the entire quiz, either from the start or from the point at which they left the test.

Although the testing part of the courseware does not provide users with an overall score, it does provide them with instant feedback and so users learn the correct answer without suffering any loss of confidence.

3.6 Placement of graphics

Irrelevant graphics/sounds/video should not be included on any web page (Nielsen, 2000) and the e-Learning environment is no different. The colour association of each Hiragana character is obviously important to this courseware. However, how to

display the colour association was essential to the design process. Displaying all 46 characters, complete with colours, on one screen could have been criticised as ''chartjunk'' (Tufte, 1983). Ultimately we decided to present all 46 black characters on a plain white grid.

Unnecessary and distracting content can clutter the screen and makes it difficult for learners to focus on the task in hand. Usability testing revealed that although the screen was uncluttered with just the necessary elements displayed, some of the Hiragana characters were not adequately centred. Consequently, in the revised version of the courseware all of the characters are centred on screen.

3.7 Pedagogical agents

There has been much research in the area of pedagogical agents. Online or pedagogical agents are characters that pop up on the screen to help guide learners, or give them feedback (Clark & Mayer, 2003). The initial research shows that while they can help learning, animated characters are just as effective as a real person, but that a real voice (for audio) is more effective than a computer generated voice. However, further research is needed. During our usability testing, it seemed that a ''virtual guide'' would not be necessary. The courseware initially included a ''smiley face'' as part of the testing section. The character provided feedback to the learners throughout the quiz, smiling when an answer was correct and frowning when an incorrect choice was clicked. However, testers' response to the face, whether smiling or frowning, was that it was unnecessary and even ''creepy''.

One of the biggest failings with e-Learning courseware is that some testing allows users to ''learn'' the sequence of answers. This means that many learners do not properly understand why an answer is correct. Having already taken the test they have merely learned off the order of answers and so they are not really processing information. However, this courseware is based on recognition. Therefore the content lends itself to this method of testing and all recognition is beneficial to learners.
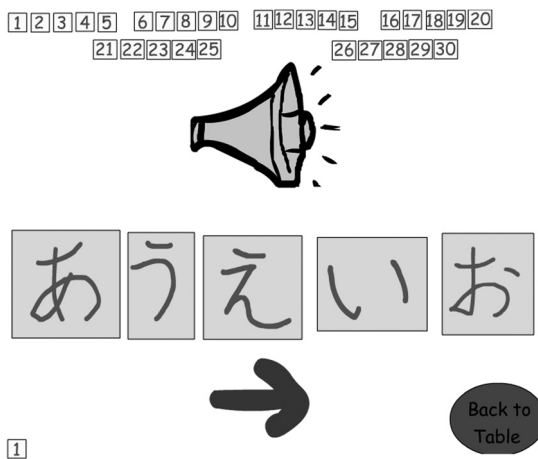
Screenshot 3: First screen from Testing section showing navigation and multiple choice.

4 The pilot study

We conducted a small-scale pilot study with a control group of three members and an experimental group, also of three members. The control, or Card group studied the hiragana using the coloured cards over two two-hour sessions a week apart, while the experimental, or Courseware group used the courseware. The Courseware group are known as X Y and Z and the Card group as A B and C.

4.1 Language background of participants

All the participants were native English speakers, came from different course backgrounds across the university and all had had some language learning experience before, mainly having learned Irish and French or German. One participant, Learner Y, had studied French and German to degree level. Learner Z and learner A, each in different groups were the only male participants and had had some contact with the Japanese language.

4.2 The learning sessions

The Card group had two two-hour sessions learning hiragana using the coloured cards. The instructor introduced the colour combinations and the sounds associated with them, and then introduced the hiragana associated with that colour combination when the sound-colour combination had been well established. This was followed by practice of each line of characters, individually and as a group. The Courseware group also had two two-hour sessions, using the CD in the CALL lab. The Courseware group were given no instruction, but encouraged to use the instructions on the CD and interact with the material in whatever way they felt appropriate to them.

4.2.1 The Card group.   Learners in this group had a high level of motivation, spoke to each other about the project and seemed excited and happy to be taking part. However, during the first session, the group also had a very noticeable need for breaks to forestall fatigue. Learner A was confident, as was learner B. Learner C was very highly motivated, but was not as successful in associating the sounds and shapes of the characters and visibly lost confidence as time went on. At this point, the possible negative effects of the group dynamic became evident in learner C's growing distress. When asked if they wanted to learn to write the hiragana, the group felt that it was beyond them at that point, and seemed rather overwhelmed by the suggestion.

4.2.1 The Courseware group.   The Courseware group were also highly motivated: they sat at the computers and began using the courseware immediately. There was no small talk among them and very little questioning about what to do. Each of them used the courseware in a different way: some focussing on the colours, one practising writing characters in the air, and one making written charts almost from the beginning. The group were completely absorbed in what they were doing throughout the first session, and hardly noticed our presence as we observed them work. There was an exciting sense of being in the presence of real, autonomous learning in the lab. In contrast to the Card group, the group were completely absorbed, working without

breaks for the whole two hours. While it took the Card group a half hour to become familiar with 20 hiragana characters, the Courseware group had viewed the whole table during the first half-hour and had listened to the pronunciation of the characters as well as seeing them written. It was notable that the Courseware group began writing at an early stage without being prompted to do so.

4.2.2 Speed/autonomy. The study showed that the Courseware group were twice as fast as the Card group in introducing themselves to the whole table of characters: each member of the Courseware group interacted with the material on the CD ROM in a different way. The Card group, however, received all their input from the instructor at the same time and so were not able to work at their own speed or decide how they would address the material.

4.2.3 Affective elements. The impact of affect and group dynamics became evident early on in the Card group's sessions, with one member manifesting a high level of anxiety. In contrast, the Courseware group did not interact with each other. There were very high levels of concentration and engagement within this group, but no feeling of competitiveness, since group members could not see how other participants were working with the material. This lack of group consciousness and sense of competition seems to have made learning and testing less stressful for them.

4.2.4 Attitude to testing. There was a very marked difference in the attitude of the two groups to the prospect of being tested. The Courseware group had a consistently positive attitude to getting feedback. Indeed, their anticipation of the testing was so positive that the button had to be removed to keep them from taking the test prematurely. Both the usability testers and the Courseware group shared an enthusiasm for the instant feedback that the test offered. Later groups have used the testing feature at different stages of their learning, with no obvious ill-effects: we were anxious about learners not taking the test before they were "ready" – seeing it as terminal evaluation, whereas some learners incorporated the test into their acquisition of hiragana as a kind of formative evaluation. This is an instructive instance of how important it is, when promoting autonomous learning, to have the courage to hand over control to the learners (Voller, 1997). The Card group, on the other hand, were far more anxious about the prospect of the test, and needed a lot of positive reinforcement before and during the test.

4.2.5 Unexpected results. All members of the Courseware group were writing within the first five minutes, either practising writing the characters in the air, or on paper: in contrast, the Card group felt that writing the characters would be too much at that early stage of their learning. The Courseware group's spontaneous interest in actually writing the characters is an instance of technology promoting traditional skills in learners.

5 Comments from learners

After the pilot study, we needed qualitative feedback on the courseware from the target group it had been designed for. The zero-beginner Japanese class agreed to give us their reaction to using the courseware. A group of 25 learners from six
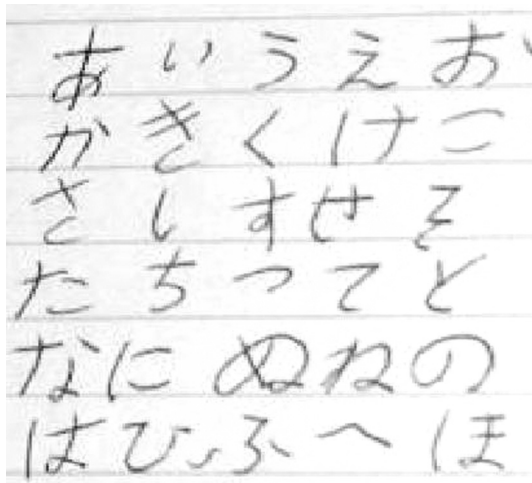
Screenshot 4: Half of the chart made by Learner Z during the first two hours using the courseware.

different undergraduate courses used the courseware for twenty minutes in the lab during their first week at college.This was a multinational group comprising learners from Ireland, China, Spain and Latvia. A total of 17 submitted learner diaries describing their experience with the courseware. It was striking that 11 of the 17 mentioned being able to work at their own pace as one of the advantages of the courseware: "I can learn at my own pace and in my own way"; "It's like having your own personal tutor". Many of these students also mentioned the advantage of being able to take the CD home. This demonstrates an increased sense of learner autonomy.

The majority also began practising writing, with 11 of them mentioning how they began to write the characters immediately: "it teaches us how we should write" one of the Chinese learners commented. Another mentioned how pleased he was that the courseware "gave me control of the learning process". This sense of control seemed to lead not only to higher motivation: "I am looking forward to learning" but to reduced feelings of stress. One learner commented: "There is no pressure or fear of doing something wrong". In common with a number of other learners, she felt that the test was motivational, being pleased with her results.

Learners' comments indicated that they felt a blended approach was necessary as five of them mentioned anxiety about the lack of explicit correction of pronunciation when using the courseware. Others were anxious about their progress in relation to their classmates, though this worry was expressed by only two of them. Both of these were mature students and both displayed considerable nervousness about using the software without explicit direction.

Kupetz and Ziegenmeyer (2006: 66) identify, among others, the following characteristics of educational technology promoting autonomy. It:

- involves problem solving activities;
- encourages active learning;

- is motivating and relevant;
- is flexible;
- avoids embarrassment to students;
- involves a dialogue about learning;
- responds to individual differences.

The major advantage of the current courseware is that control is handed over to learners, and they are completely engaged when using it. Their own individual style of learning is accommodated with regard to speed, pace of learning and the order in which they learn. It also provides them with a personal learning experience which seems to reduce the feeling of competitiveness and language anxiety in the group. Learners using the courseware are highly motivated and consistently keen to test themselves, in contrast to the obvious stress felt by groups using other methods. An unexpected feature of learners' interaction with the courseware was the speed with which they began to write: their formation of the characters at such an early stage in their acquisition of the language was impressive and compared very favourably with previous groups of learners using paper-based methods. As the objectives of the courseware are extremely specific and measurable, its optimal use is in a blended learning environment where other skills are introduced and practised. Experience to date, however, shows that in the learning of one Japanese character set, it is significantly more effective than paper-based methods.

References

Alessi, S. M. and Trollip, S. R. (2001) *Multimedia for learning methods and development* (3rd edition). Boston: Allyn and Bacon.

Chang, S.-H., Lin, P.-C. and Lin, Z. C. (2007) Measures of partial knowledge and unexpected responses in multiple-choice tests. *Educational Technology & Society*, **10**(4): 95–109.

Clark, R. and Mayer, R. (2003) *E-Learning and the science of instruction : proven guidelines for consumers and designers of multimedia learning*. San Francisco: Jossey-Bass/Pfeiffer.

Gattegno, C. (1978) *Teaching foreign languages in schools: The silent way*. New York: Educational Solutions.

Hasegawa, N. (2005) Koukateki na hiragana jyugyou ni mukete *Nichigen Jisshuu Repoto*, Nagoya University. http://www.lang.nagoya-u.ac.jp/nichigen/menu5_folder/jisshu/2005/index.htm

Hatasa, K. (1991) Teaching Japanese syllabary with visual and verbal mnemonics. *CALICO Journal*, **8**(3): 69–80.

IEEE Standards Committee (2002) *IEEE Standard for Learning Object Metadata. IEEE Standard 1484.12.1*. New York: Institute of Electrical and Electronics Engineers. http://ieeexplore.ieee.org/iel5/8032/22180/01032843.pdf?arnumber=1032843

Kamiyama, T. (1973) How to teach reading in the beginning 50 hours. *Journal of the Association of Teachers of Japanese*, **8**(2): 47–54.

Kupetz, R. and Ziegenmeyer, B. (2006) Flexible learning activities fostering autonomy in teaching training. *ReCALL*, **18**(1): 63–82.

Nielsen, J. (2000) *Designing Web Usability*. Indianapolis, Ind.: New Riders.

O'Neill, P. G. (1967) *Japanese Kana workbook*. Tokyo and New York: Kodansha.

Oxford, R. L. (1999) Anxiety and the Language Learner: New Insights. In: Arnold, J. (ed.), *Affect in Language Learning*. Cambridge: Cambridge University Press, 58–67.

Quackenbush, H. and Ohso, M. (1989) *Hiragana in 48 minutes*. Melbourne: Curriculum Corporation.

Quackenbush, H., Nakajyou, K., Nagatomo, K. and Tawada, I. (1989) Gojuppun hiragana dounyuhou – 'rensouhou' to 'irotsukikadohou' no hikaku. *Nihongokyouiku*, **69**: 147–162.

Ruddock, K. (2000) An argument for the use of authentic texts with beginners of Japanese as a foreign language. CLCS Occasional Paper 58. Dublin: TCD.

Shriver, K. (1996) *Dynamics of document design*. New York: Wiley.

Thompson, J. D. and Wakefield, J. F. (1996) Picture this character: using imagery to teach a Japanese syllabary. Paper presented at the Annual Meeting of the Mid-South Educational Research Association, Alabama.

Tsujimura, M. (1995) "nyumonki ni okeru hiraganagakushushidoho ni kan suru ichikosatsu -gemu de manabuho". Departmental Bulletin Paper, **30,** Waseda University Japanese Education Research Centre, 149–158.

Tufte, E. (1983) *The visual display of quantitative information*. Cheshire, Conn: Graphics Press.

University of Illinois Department of Ophthalmology and Visual Sciences (2007). http://www.uic.edu/com/eye/LearningAboutVision/EyeFacts/

Voller, P. (1997) Does the Teacher have a Role in Autonomous Language Learning? In: Benson, P. and Voller, P. (eds.), *Autonomy and Independence in Language Learning*. New York: Addison Wesley Longman, 98–113.