

Review of the “Web:How2SolveIt” Website

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Abstract

Web:How2SolveIt is a website provided for Gakushuin University to help students understand maths concepts, mainly in the areas of Economics and Business. The site offers a practical collection of quality study material, with useful videos.

The site has been evaluated by “walking through” the student interface, applying some typical user cases, which are typical usage stories of student users. We recommend a few changes to the site, which would help students to find what they need easily, making it more attractive for students and for academics who contribute their materials. For example, the Home Page should give more useful context information and a text-entry search box should always be visible, with which students can navigate the collection of teaching resources.

An attractive feature of the site is the hand-written question sheets, which explain or amplify important teaching points. Some changes to the presentation of the sheets and the videos would make them easier for students to follow.

A usability study, where a small number of volunteers from the target demographic are observed while carrying out typical tasks, would quickly and cheaply give valuable insight into the way that real users respond to the site.

Directions for possible future development of the site include:

Adding further explanations, videos, notes and formulae to cover further topics in Business Maths

Adding further content from other lecturers

Offering the site to other students outside the Economics Faculty

Offering the site to High School Students

Developing a bi-lingual version of the site for teaching through the medium of English as well as Japanese

These future directions would involve varying degrees of additional effort and investment.

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1. Purpose and Context of the Website

1.1 Context

Web:How2SolveIt is a website provided for Gakushuin University to help students (mostly undergraduate) understand maths concepts, mainly in the areas of Economics and Business (see Figure 1). It offers a large collection of explanations for solving set questions in Business Maths.

The main developer of the site is Shirota and her purpose in creating this website is “To reduce human labour cost in teaching and explaining a concept repeatedly”. The **Web:How2SolveIt** website and associated workflow have been designed at reasonable cost, having regard to the present scope of use within a Faculty of the University.

The site was initially conceived as a supplement to the Shirota’s own book (Shirota, 2009) and courses taught by her in the Faculty of Economics at Gakushuin University. Further material has been added by other teaching members of staff, and it is hoped that this collection will grow (see parts 5.3-5.5 below).

Although many other e-learning systems for math education offer only simple drill problems, **Web:How2SolveIt** provides higher-level problems such as financial mathematics to the students. This site is intended for individual study and the key feature is in-depth and careful explanation to students, using audio and visual media.

1.2 Purpose of This Report

The site offers a practical collection of quality study material, with useful videos.

A few changes would make it easier for students to find what they need, making it more attractive for students and for academics who contribute their materials.

The site was developed during 2011-2012 and came into service in May 2012. Then, in September 2012, we asked Stanworth to evaluate the site in detail, at the campus, and give us technical advice for improvements to the site. The report describes improvements of the current version of the site and our future work.



Figure 1: The Home Page of *Web:How2SolveIt*

1.3 Resources Provided in the Website

The teaching sheets presented in the **Web:How2SolveIt** website have been collected over some years of teaching Business Maths to undergraduate students at Gakushuin University.

When a student asks the lecturer a question about his/her work, both question and answer are handwritten on a specially-designed enquiry form. These teaching sheets are uploaded to **Web:How2SolveIt** for the benefit of all the students (see Figure 2).

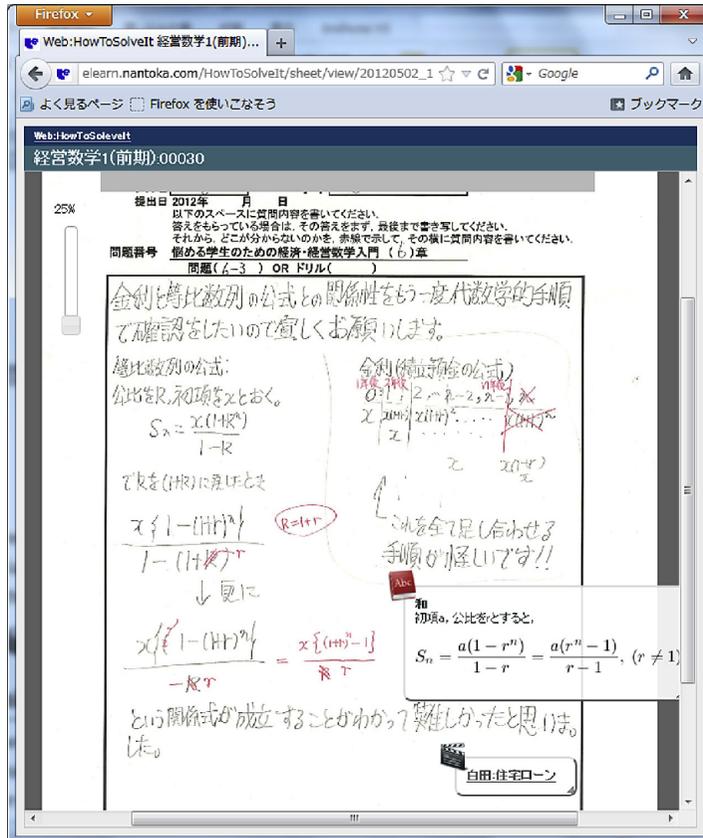


Figure 2: A sample question written by a student and responses written by the lecturer

Icons such as    indicate where extra material such as a note, formula or video is available.

A notable feature of the system is the video material created by the lecturer which would answer the student's question.

2. Method of This Report

In this report, we review the website as it stands (autumn 2012) with some suggestions for possible improvements and revisions that would make it more user-friendly and some comments about future

directions for the project. This section will describe how the site was evaluated, which features a narrative approach, a heuristic evaluation, and user cases.

2.1 Narrative Approach

The authors visited the student interface of the site, and “walked through” a typical journey around the pages, exploring as a typical user might do, noting features and likely uses.

The site designer and developer (Shirota) assisted the evaluator (Stanworth) in exploring the site, explaining the purpose of each part and translating some of the text from Japanese to English.

We do not comment here on the editor’s interface, which is used by just a few members of staff in creating material.

2.2 Heuristic Evaluation

Nielsen (Nielsen, 2005) provides a useful framework for evaluating the usability of a website (summarised in Appendix One). We shall use his framework to evaluate the site. **Web:How2SolveIt** is unusual in being intended for a narrowly-defined audience, that of undergraduate students of Business Maths, so the requirements of a commercial or information site for the general public do not all apply. Basically Nielsen’s framework is one for general service sites. However, Nielsen’s framework gives us a good basis for thinking systematically about a website.

2.3 Note on Translation

We now comment on the question of language translation. The command menus are all in Japanese, and almost all the teaching materials are also written in Japanese. As Stanworth does not understand Japanese, some translation was needed for her. In addition, we used the translation function of Google Translator. The live site was viewed via the Google Translator (in the Chrome browser) as shown in Figure 3. The machine-translated phrases sometimes appear clumsy in English, but we cannot comment on the phrasing in Japanese.

2.4 User Cases

In evaluating the website, we should consider several common user cases which are typical stories of student usage. By considering these cases of typical usage, we will be able to evaluate the site more effectively. These “stories” help us focus on likely ways that visitors may use the site. They are not exhaustive but provide a useful basis for exploring and for examining the use of the website. In the following, nine user cases we are aware of in student experience are described.

Coursework

A student is following a taught course at the University. In a recent lecture, a topic was discussed but the student did not understand it. This student would like to read about the topic with an explanation. For example, Figure 4 shows a topic about compounding interest rate.

Review of the "Web:How2SolveIt" Website (Stanworth and Shiota)

The screenshot shows a web browser window displaying a list of questionnaires. The page title is "List of questionnaires" and the URL is "elearn.nantoka.com/howToSolveIt/sheet/list?sheettype=2". The page is translated from Japanese to English. Below the navigation bar, there is a search bar and a list of questionnaires. The list is organized into a table with columns for No., Type, Filing date, Department, Edit, Correction, Yuan, Title, and Note.

No.	Type	Filing date	Department	Edit	Correction	Yuan	Title	Note
Q0120	One business mathematics (year)	2012/04/16	1 year Department of Business	☑	✓	☐	Shirota 4-III 2-1 (2), (3)	
Q0121	One business mathematics (year)	2012/04/16	1 year Department of Business	☑	✓	☐	Shirota 4-III 2-2 (4)	
Q0122	One business mathematics (year)	2012/04/16	1 year Department of Business	☑	✓	☐	D-III 2-6 (1) Shirota	
Q0123	One business mathematics (year)	2012/04/16	1 year Department of Business	☑	✓	☐	Shirota 4-III 2-7 (4)	
Q0127	One business mathematics (year)	2012/05/02	8-year Department of Business	☑	✓	☐	6-3 Issue: Shirota	Slava notation
Q0128	One business mathematics (year)	2012/05/02	8-year Department of Business	☑	✓	☐	6-3 Issue: Shirota	
Q0129	One business mathematics (year)	2012/05/02	8-year Department of Business	☑	✓	☐	6-3 Issue: Shirota	
Q0130	One business mathematics (year)	2012/05/02	8-year Department of Business	☑	✓	☐	6-3 Issue: Shirota	Mortgage
Q0131	One business mathematics (year)	01/06/2012	1 year Department of Business	☑	✓	☐	D-III test # 1 (2012/5/10) Shirota	Test answers
Q0132	One business mathematics (year)	01/06/2012	Department and other management	☑	✓	☐	4-1 Issue: Shirota	Operation Maps
Q0133	One business mathematics (year)	01/06/2012	8-year Department of Business	☑	✓	☐	4-1 Issue: Shirota	National Income determination
Q0137	One business mathematics (year)	2012/05/31	1 year Department of Business	☑	✓	☐	D-III 6-2 Shirota	Continuous compounding
Q0138	One business mathematics (year)	2012/05/31	1 year Department of Business	☑	✓	☐	D-III 6-2 Shirota	Continuous compounding
Q0139	One business mathematics (year)	2012/05/31	1 year Department of Business	☑	✓	☐	6-1 d-III	
Q0150	One business mathematics (year)	2012/05/31	1 year Department of Business	☑	✓	☐	Maple Implicit function	
Q0121	One business mathematics (year)	2012/06/07	1 year Department of Business	☑	✓	☐	D-III test # 2 (2012/5/07) Shirota	
Q0152	One business mathematics (year)	2012/06/28	1 year Department of Business	☑	✓	☐	2 national income questionnaires: Shirota	
Q0153	One business mathematics (year)	2012/06/28	1 year Department of Business	☑	✓	☐	National Income determination questionnaire 2: Shirota	

Figure 3: View of the *Web:How2SolveIt* site in English translation (Google Chrome)

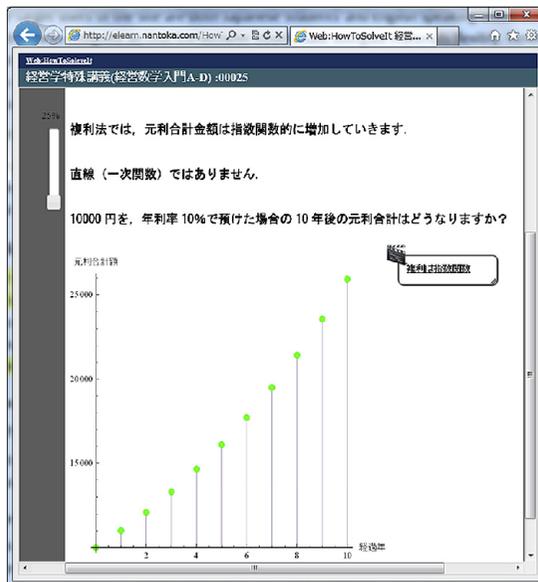


Figure 4: Sample of a coursework topic

Standard Formulae

This student attended a lecture or read part of the text-book, which mentioned a concept or formula which the student does not recall. The concept or formula may have been covered earlier in this course, or in a previous course. This student would like to be reminded of a standard concept or formula.

Derivations and Algebra

Figure 5 shows a hand-written question from a student about an algebraic transformation.

The question is underlined in red. This student followed a lecture or read a text-book chapter but did not understand the way the expressions were derived. The student would like the steps of the derivation to be spelt out in more detail. The lecturer's video explaining the answer is also available. In the video, the lecturer's voice is heard explaining the transformation on this teaching sheet, as the mouse pointer moves.

The screenshot shows a web browser window with a handwritten algebraic derivation. The derivation is as follows:

$$\begin{aligned}
 Y_d &= C + I \\
 C &= a + bY', \quad a = 120, \quad b = 0.8 \quad c = 120 + 0.8Y' \\
 T &= T_0 + tY', \quad t = 0.2 \\
 Y' &= Y - T \\
 I &= I_0 + 0.1Y' \quad (I_0 = 35) \\
 T_0 & \text{が } 10 \text{ が } 20 \text{ に } 2 \text{ 倍 } \rightarrow 10 \text{ の } 2 \text{ 倍 } \text{ の } \text{ 平均 } \text{ 国民 } \text{ 所得 } \text{ 付 } ?
 \end{aligned}$$

The main derivation steps are:

$$\begin{aligned}
 A. \quad Y &= 120 + 0.8(Y - T_0 + 0.2Y) + 35 + 0.1(Y - T_0 + 0.2Y) \\
 &= 155 + 0.9(0.8Y - T_0) \\
 &= 155 + 0.72Y - 0.9T_0 \\
 &= 0.28Y = 155 - 0.9T_0 \\
 Y &= 553.57 - 3.2(0.2T_0) \\
 \bullet \quad T_0 &= 10 \text{ の } 2 \text{ 倍 } \quad 521.9 \\
 \bullet \quad T_0 &= 20 \text{ の } 2 \text{ 倍 } \quad 999.3
 \end{aligned}$$

Handwritten notes in Japanese include:

- 上の下の式の變形ができません。
- 展開して代入していきます。
- Y = 120 + 0.8Y - 0.8T_0 + 0.16Y + 35 + 0.1(Y - 0.1T_0 + 0.02Y)
- Y = 155 + 0.9(Y - (T_0 + 0.2Y))

Figure 5: Sample of an explanation of an algebraic transformation

Topic Revision for Exam

This student is revising for an exam at the end of term. He does not understand a certain concept in the text-book, and would like an explanation that fits coherently with the printed account.

A Model Exam Answer

Just after examinations, the solutions are published on the site, where students can browse and study the model solutions (see Figure 6). Students revising for a later exam would like to work through past exam questions, with indications of what would be expected in a correct answer.

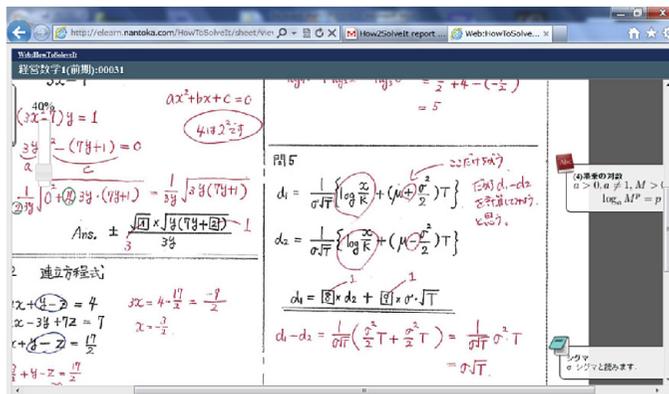


Figure 6: Model answer for an examination

A Common Difficulty

The lecturer is aware that students often have trouble with a particular maths concept. Knowing that some will need help, the lecturer wants to provide an explanation that they can find whenever they need it. Several students will benefit, at any time during the academic year. These are also presented as questions and answers, using the enquiry form.

A Busy Lecturer

This lecturer does not have time to invest in helping individual students with their work (see Figure 7). The lecturer would like to explain a concept once, and have all the students make use of the explanation when they need help.

Public Presentation of University Teaching

It is sometimes said, both in Japan and in the UK, that the standard of maths skills among students, on arrival at university, is declining. When this is combined with the fall in population numbers in Japan, there is said to be a downward pressure on university teaching. A university needs to demonstrate that it is providing an excellent education with good personal support and help for each student.

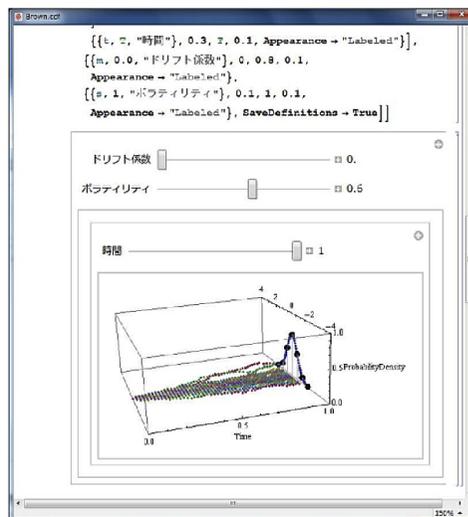


Figure 7: A busy lecturer uses Web:How2SolveIt to avoid repeatedly explaining the same topic to the same questions; furthermore, students can study the topic at any time

3 Narrative Tour of the Site

3.1 General Appearance and Layout of the Site

The website has a clean, sober appearance. The blue and grey colour scheme implies authority and

does not distract from the content. However, a slightly larger and more attractive font could give a more modern appearance.

3.2 Header and Footer

It has become standard website design to have a link always available which visitors can click to return to the Home Page, and it is useful to provide this at top left. The **Web:How2SolveIt** label does this well, and it could be made bigger and more distinctive, perhaps developing it with a characteristic font into a simple icon. Meanwhile, the exact spelling of **Web:How2SolveIt** may need to be checked.

Other features to put in the header would be anything that always needs to be visible, such as a search box (see part 3.6 below) and a toggle between languages if that is implemented (see part 5.8 below).

In a footer, it is common practice to provide links to related webpages, in support of the present content. This might include links to a simple Contact Us page, a statement of copyright, the Gakushuin University or Economics Faculty home pages or perhaps other pages that visitors to this site would also find useful. This approach is illustrated at the University of Oxford's website "ITLP Portfolio" (IT Learning Programme at Oxford University, 2012)

3.3 Login and Logout

Visitors to the site must log in before they can see the content.

However, once a visitor is logged in it is not clear how to actively log out. Internet users are often encouraged to remember to log out of any site they visit, to maintain the security of their resources, so it would be good practice to provide for this, e.g. with a Logout link at the right of the header.

3.4 Static Information Pages

The site would benefit from having a few static webpages, giving extra information for users. This would typically include brief instructions on how to contact the site owner, how to report any problems, advice for new visitors, and a statement of copyright information. These pages would be found using links in the footer (see part 3.2 above).

This improvement is likely to reduce the numbers of enquiries received from students.

3.5 Home Page

The Home Page is the first part of the website that visitors see. This is the place to provide information for all visitors, to set the tone and to manage their expectations of the content available.

The Home Page needs a prominent explanation for new visitors who do not know the site already, perhaps along these lines:

"Welcome to the **Web:How2SolveIt** website. This site provides ... [what kind of information is available] It will be useful for ... [what sort of people]"

[Briefly explain the relationship between this material and one or more text-books, giving reference information ...]

An "Announcements" panel would be another useful provision, where a variety of time-dependent announcements could be posted as they occur, and removed as they go out of date. For example a brief

note could announce the arrival of new material, or highlight material that is relevant to an imminent exam.

3.6 Searching

At present, a useful search box is provided at top of search results page. This is central to the use of the site, especially as the amount of content grows.

The most significant change to make the site more usable would be to provide a more detailed way of searching, in line with what is found in other similar websites.

Work with the student and young adult demographic (Radia, 2011) has shown firmly that a “search box” is their preferred way in to any new site - as popularised by Google. This is a type-in box where the visitor types one or more keywords, which are matched in a list of search results. The search box should appear prominently on the Home Page, with a smaller search box always available in the header.

It may also be useful to offer other routes for searching the site. Each search route could be offered on the Home Page as a pick-list or combo box that lists the options available, for example:

- Choose a **chapter** in the text-book
(by selecting the text-book then the chapters and sections)
- Choose a taught **course** (selecting the title and the lecturer)
- Choose a previous **exam paper**
- Choose a **topic**
- Choose a **formula** (from a list of those available)

3.7 Search Results Page



Figure 8: The current search results page

A search box is currently provided on the search results page (see Figure 8), where its operation can be unpredictable. It needs to be made clear whether in applying a search string the user is further filtering the results currently shown, or doing a fresh search.

In the list of teaching sheets, the first column currently shown is a serial number, and this is set as the “hot link” which the visitor clicks to view the chosen teaching sheet. This serial number is not directly meaningful to the visitor (although it has meaning to the lecturer and editor of the material), so it should not be displayed. Another field, such as the sheet title, would be a more intuitive choice for the clickable link.

It may be more efficient to display the name of the lecturer who contributed each teaching sheet, as a separate field in the search results. At present this is usually combined as part of the title such as “Shirota: drill2-1(a)”. As a separate field, this would provide a good basis for sorting and searching.

If the collection of resources grows significantly, then a future development would be to provide a faceted search. This is where the user has controls for reducing the number of items listed by choosing between categories. An advanced example of this is familiar to users of Amazon’s shopping website. A simpler example is implemented in Oxford’s ITLP Portfolio (IT Learning Programme at Oxford University) (where the faceted search is provided by the “API Search” module of the Drupal content management system).

3.8 Teaching Sheets

An attractive feature of the teaching sheets is the hand-written explanations. These are scanned by the teacher, to create JPEG images for students to study.

The author Shirota has a professional commitment to the value of both students and teachers handwriting their material, which stimulates clear and logical thought. The paper-based enquiry forms which provide the basis of the **Web:How2SolveIt** material, and the videos derived from them, are presented in the teacher’s and the students’ authentic hand-writing. This gives a strong personal impression of the teacher helping the student.

Some teaching sheets are a response to an individual student’s enquiry: students write questions in their own handwriting and underline the questions in a different colour. The lecturer provides an explanation and a recommended answer in different coloured ink.

Creating teaching sheets and videos is a low-cost activity for lecturers: it is reported to take around 5 minutes to write out a clear hand-written question-and-answer teaching sheet, and around 20 minutes to rehearse and record a video. This report cannot comment on the maths used or the explanations given.

3.9 Videos, Formulae, Notes

If a student still requires help, after reading a teaching sheet, more support is available:

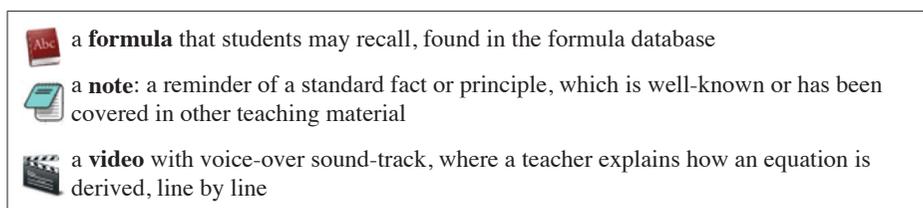


Figure 9: Icons for additional material in a teaching sheet

These notes, formulae and videos have been created separately and organised into a database where they can be linked efficiently. Links to relevant notes, formulae and videos are embedded in the teaching sheets, where the visitor can click to view and hear them. For example, a particular formula may be referenced from several teaching sheets and *vice versa*.

If it became necessary for students to refer directly to a formula, note or video (rather than via a teaching sheet) a separate search tool would be needed for selecting these. This does not seem to be needed at present.

Videos with Voice-over

The video voice-overs have an informal, friendly style. If a few stumbles and pauses occur, these add to the personal style and the sense of being helped by the lecturer. Gakushuin University has a tradition of personal teaching attention and face-to-face communication, and the **Web:How2SolveIt** site supports this traditional approach.

In the videos, the lecturer's face does not appear. The screen-captured recordings are offered as video material with voice-over only. This approach greatly reduces the cost of making the videos and the lecturer's work-load.

Some of the videos might be made simpler to follow if the algebra was revealed progressively. So, while working through a derivation, each line of algebra is revealed as it is discussed, so the viewer can focus on one line at a time. This can be achieved by dragging a white box gradually down the screen over the Q&A form, revealing one line of algebra at a time. This helps the student concentrate on the lines of the maths derivation as it develops. In the videos, some of the software toolbars and menus could be hidden or cropped away, to help the student to focus on the progress of the derivation (as illustrated in Figure 10).

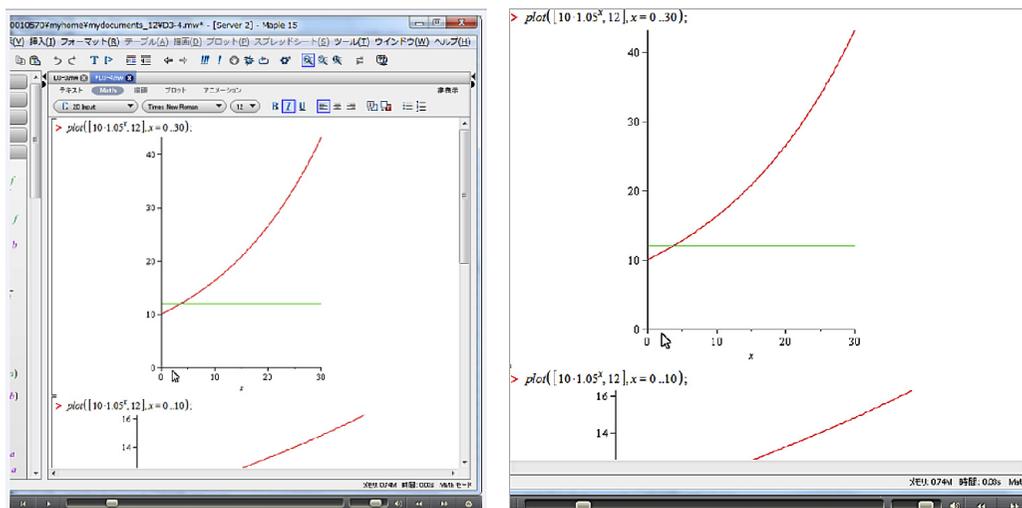


Figure 10: Effect of cropping to clarify a video explanation

Formulae

A formula may appear within a teaching sheet, marked with an icon.

The database of formulae is a collection of expressions which are well-known or have been covered in other teaching material. Each formula is built using **LaTeX**, and uploaded to the formulae database. The

same formula may be referenced by several teaching sheets or videos.

Many widely-used standard maths formulae are given at the front pages of the accompanying textbook (Shirota, 2009), and widely-used standard economics formulae are given at the end pages. Conventional notation and symbols are used, as seen in internationally-recognised text-books such as (Jacques, 2003).

4 Summary of Recommendations

In this account, a “link” is a piece of text or an image or button that a user can click to move to another web-page.

Search:

- provide a more detailed way of searching
- a Google-style type-in text box is a popular way for students to search for the material they need
- a prominent search box on the Home Page
- a smaller search box always visible in the header
- consider providing several modes of searching, such as by text-book chapter, by course, by topic, by teacher

The search function needs to be clearly understood:

- in entering a search string the user must know whether they are doing a fresh search or filtering the results currently shown

Font:

- a larger and more attractive font, especially for headings

Header always visible:

- a distinctive icon with a link that returns to the home page
- search box
- Login / Logout link
- flip-flop between languages (if implemented in future)

Footer always visible has links to:

- Contact Us page
- a statement of copyright
- the Gakushuin University or Economics Faculty home pages
- other useful pages

Static pages with context information for visitors, such as:

- brief instructions on how to contact the site owner
- how to report any problems
- advice for new visitors
- a statement of copyright information

The Home Page needs:

- a prominent explanation for new visitors of the purpose and context of the site
- announcements panel, announcing new material or high-lighting items of current interest

Search results page:

- do not display the sheet serial number to student visitors
- to choose a teaching sheet, the user should click a “hot link” which is the sheet title or another factor easily understood (rather than the sheet serial number)
- display the name of the lecturer who contributed each teaching sheet, as a separate field
- consider offering a faceted search for filtering the search results, if the collection of material grows large (as available in content management systems such as Drupal)

Videos with narration:

- reveal the page of algebra progressively, as each line is mentioned in the narration - this helps students concentrate
- hide or crop away any toolbars or menus that are not relevant to the teaching point

5. Future Work

The significance of the **Web:How2SolveIt** website is that it *adds value* to an existing taught course. A student who is following the Business Maths course in the Economics Faculty can find extra support, to help them understand the material covered in class and in the text-book. Explanations are presented in the teacher’s own handwriting and narrated by the teacher’s own voice.

Many web sites are targeted at the general public, and their materials designed to be widely available. In the present case, however, **Web:How2SolveIt** is not targeted at the general public but offers services to individuals who work together. The student users of the system are assumed to know the lecturer who made the video materials. Then the lecturer’s personal voice effectively encourages the students. This is consistent with the “Many-to-One” approach to effective teaching described by Arnold King (King).

This project could develop in several different directions; some are likely to take a higher priority with the department, whereas some are more long-term.

5.1 Usability Study with Typical Users

Nielsen (Nielsen, 2005, 2012), Krug (Krug, 2010), Snyder (Snyder, 2003) and other experienced web designers recommend that any website benefits from a brief and informal *usability study*.

This is a practical exercise where a set of user cases are drawn up (a *user case* describes a particular kind of user and a typical task they might want to carry out in the site) and tested. Some volunteer users, who are typical of the expected audience but have no previous experience of this site, are invited to try out the site and attempt one or more tasks. An evaluator observes their progress and notices points where the user is surprised, confused or stuck.

Such a study can quickly give valuable insight into the way real users find their way around the site, and will suggest changes that would bring real improvement.

Experience at the IT Learning Programme at the University of Oxford (Radia, 2011) has proved that a usability study with just 4 to 6 typical users quickly and cheaply provides valuable insight.

5.2 Developing Traction in the Target Community

As more content is added, the collection will grow in value and is likely to develop traction in the

student community at Gakushuin University.

As students become familiar with the site, and discover the range of high-quality materials available which directly support their studies, they will develop the habit of looking here for help and explanation. This would gradually reduce the load on lecturers, of handling repeated enquiries.

5.3 Additional Content

Shirota intends to build up this collection of explanations, videos, notes and formulae to cover further topics. This will support Shirota's teaching at Gakushuin University and her Business Maths text-books.

Initially, the website offers a number of teaching sheets in the "Business Maths 1" category and a few in "Special Lecture in Business Admin". Here the category name corresponds to the lecture title. Other categories, such as "Business Maths 2" or "Introduction to Management Exercises", are mentioned, so more teaching sheets are likely to be planned, as resources allow.

Shirota's next ambition is to create teaching sheets and videos to accompany each worked example in the text-book (shown printed in grey boxes), with voice-over to provide extra help in understanding the work.

5.4 Wider Range of Text-Book Support

At present, the whole site is closely tied to the text-book by Shirota (Shirota, 2009). A student is expected to ask a question by reference to the chapter number and the question number. This is an inherent limitation on the structure, but could readily be expanded. A key strategic decision is needed, on whether or not to develop this.

The material in the website is organised in terms of the chapters of the text-book, but it could equally be managed by topic or theme, while still citing the connection to a text-book where relevant.

5.5 Other Teachers Contributing Material

Other members of the Economics Faculty staff at the University may add their own materials, as could contributors from further afield.

Some more materials have already been uploaded to the **Web:How2SolveIt** site, by Mr Ichikawa, the first "guest teacher". He chose to create some simple explanations without voiceover. It seems likely that each contributor will have their own style when creating materials, videos etc.

Other lecturers may need some encouragement to participate: they may not want to invest time in creating materials, but can be reassured that it will save them time in the long run.

Other teachers may create materials that are not organised by reference to a text-book, but may give each teaching sheet a description or theme. A decision to extend to other material from other courses or by other lecturers would of course mean a growth in the quantity of material stored, but need not change the structure of the content management. This would however affect the website design, particularly of the search tools on the Home Page. Some labels and descriptions would need to be more generic, as for example allowing reference to different text-books and different lecture series.

See Appendix Two for notes on creating these learning materials.

5.6 Other Students Outside the Economics Faculty

This material is not intended for broadcast. It is designed to work hand-in-hand with a taught course. The personal style of writing and audio, and the close link with a text-book, give the material an immediate appeal to students who are following this or similar courses.

A user who visits the site regularly, as part of a course or sequence of homework tasks, will learn their way around and become familiar with the layout. Users who visit only occasionally will require more assistance with orientating themselves, and will be much less tolerant of unfamiliar terms and procedures.

Users who are not attending a course at Gakushuin University nor reading one of the text-books already linked with the site may require a very different approach.

5.7 High School Students

The author Shirota would also like to add more general explanations, for other readers beyond the students in the Business Maths class. For example, high school students¹⁾ with links to Gakushuin University could benefit from the opportunity to study maths concepts in more detail. The extra explanations and detailed derivations in **Web:How2SolveIt** are available for students to study in their own time, at their own pace even when no teacher is on hand to help.

The personal style of writing and audio is suitable for a wider audience, however if the site is to appeal to teenagers, it may need a brighter look & feel, without being childish. Some expert advice would be needed for this: for example refer to the BBC’s Bitesize website (BBC) GCSE revision material which is designed for 16-year-old students preparing for UK national exams.

5.8 Bi-Lingual Version of the Site

There is an interest in using a resource of this kind for teaching students in other languages, notably English.

At present, the target users of the site are Japanese students. It may be that some students would benefit from seeing the site content in English as well as in Japanese. In particular, anyone following an International Studies curriculum may be being taught wholly or partly through the medium of English²⁾. In future, we expect that Japanese students will also have to solve business math problems in English and this may later extend to use by English-speaking foreign students.

One arrangement on the website might be to provide a button on the site header (visible from any page in the site), with which the visitor can flip-flop between the Japanese and the English versions.

At present the site appears in Japanese characters. It is possible for non-readers of characters to use a machine translator such as Google Translate (Google), which gives a reasonable view of the site contents. However non-Japanese-speaking users could not read the pages to look for their desired material and information. A bilingual set of command menus and web pages is one of the most significant future areas for future work.

1) For example, at Gakushuin High School and the sons and daughters of Gakushuin University alumni in Indonesia

2) This is potentially a big development for the University, as it considers providing international teaching.

Further, the contributed materials (videos, audio narration, teaching sheets etc.) are handwritten and spoken in Japanese and cannot be machine-translated.

Therefore the system was designed to be flexible, allowing the lecturer to create bilingual materials. The contents can alternatively be written in English: English-speaking students can write their questions in English and the lecturer can answer in English.

Converting to a bi-lingual version of the website would be a major task, essentially duplicating much of the site and its contents:

- Write all the teaching sheets, formulae, notes and videos in natural English
- Record the voice-overs with a native English speaker
- Write the website text in natural English (including the Home Page, search results, menus and static pages)
- Provide a chooser button on the Home Page and/or in the header, with which the user can select to visit either the Japanese or the English version

This would also add a permanent overhead to the editing cost, whenever the site is added to or edited in future.

Advice is needed here from web developers who are experienced in creating bi-lingual sites and also from translators who are experienced in presenting technical (maths) material in English, and are also familiar with current trends in web design. The style of the text on a site and the way it is worded (vocabulary, sentence construction, use of idiom) makes a real difference to the impression that users form, and can affect their attitude to the contents.

This may be considered as a future phase of the project.

5.9 Editors' Interface

There is a separate interface which a teacher or editor uses for creating and collecting the materials. The fairly plain tabular layout is simple and direct. Because a small number of individuals are likely to use this interface, it is not being developed for the time being.

We have not considered the tools used to create teaching materials, notes, videos and formulae, and for adding or editing material in the collection. Individual teachers may have their own preferences for tools that suit their own work.

Appendix One: Ten Usability Heuristics

by Jakob Nielsen (Nielsen, 2005) (Nielsen, 2012)

These are ten general principles for user interface design. They are called “heuristics” because they are more in the nature of rules of thumb than specific usability guidelines.

Visibility of system status

The system should always keep users informed about what is going on, through appropriate feedback within reasonable time.

Match between the system and the real world

The system should speak the users' language, with words, phrases and concepts familiar to the user, rather than system-oriented terms. Follow real-world conventions, making information appear in a natural and logical order.

User control and freedom

Users often choose system functions by mistake and will need a clearly marked "emergency exit" to leave the unwanted state without having to go through an extended dialogue. Support undo and redo.

Consistency and standards

Users should not have to wonder whether different words, situations, or actions mean the same thing. Follow platform conventions.

Error prevention

Even better than good error messages is a careful design which prevents a problem from occurring in the first place. Either eliminate error-prone conditions or check for them and present users with a confirmation option before they commit to the action.

Recognition rather than recall

Minimize the user's memory load by making objects, actions, and options visible. The user should not have to remember information from one part of the dialogue to another. Instructions for use of the system should be visible or easily retrievable whenever appropriate.

Flexibility and efficiency of use

Accelerators - unseen by the novice user - may often speed up the interaction for the expert user such that the system can cater to both inexperienced and experienced users. Allow users to tailor frequent actions.

Aesthetic and minimalist design

Dialogues should not contain information which is irrelevant or rarely needed. Every extra unit of information in a dialogue competes with the relevant units of information and diminishes their relative visibility.

Help users recognize, diagnose, and recover from errors

Error messages should be expressed in plain language (no codes), precisely indicate the problem, and constructively suggest a solution.

Help and documentation

Even though it is better if the system can be used without documentation, it may be necessary to provide help and documentation. Any such information should be easy to search, focused on the user's

task, list concrete steps to be carried out, and not be too large.

Appendix Two: Creating the Learning Materials

Creating these materials, especially the videos, is a substantial undertaking. Producing even a 1minute video takes several steps:

Plan the sequence of steps (they must be logical, clear and easy to follow)

Write out the demonstration teaching sheet and scan to make a JPG or PDF that can be displayed on the screen

Practice the narration with actions and mouse gestures

Record the steps as actions, mouse gestures and voice-over

Save the recording

Upload the recording to **Web:How2SolveIt** and annotate it

These resources were created using **ViewLetCam** and **Web:How2SolveIt** software. This author Shirota is very experienced and fluent at this, and can produce a finished video in the extraordinarily short time of around 30 minutes to rehearse and record a video. However, it is generally recognised among elearning practitioners that a more typical author should allow substantially more time to design and create a recording.

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