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Active content for preparation of teaching materials

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Abstract

Teaching materials such as study guides have implicit structure that can be exploited to explicitly assist in the learning and teaching process. Document technologies specific to the teaching context generate visible structures and linkages in a consistent manner across multiple course materials. We describe techniques that:

- Create, manage and validate links between the learning objectives, content related to each objective and corresponding assessment task.
- Explicitly present relationships between concepts, as a concept map, related to unit content and external study resources.
- Treat various study resources (study guide, presentation slides) as consistent views.
- Facilitate the use of external media to support multiple modalities.

The process creates teaching content as a single master document which is annotated to: identify learning outcomes associated with topics and exercises, relationships between concepts covered, references to external resources and media, as well as summary points and keywords. Different views of this master document produce the range of course documentation.

Examples of documents include: a study guide with learning outcomes linked to content, concept maps providing a graphical view of key relationships, and presentation slides that generate visual mnemonics for important topics.

While this structure simplifies formatting of learning materials it also offers additional benefits to the teacher. Reports are generated showing that all outcomes are covered and assessed. Explicitly annotating and visualizing concepts allows the lecturer to ensure that all elements fall within a single scaffold. Simplified access to external media encourages alternative presentation modalities and produces presentations that are easily adapted to new themes.

Learning Outcomes

On completion of this unit students will be able to:

Outcome 1: Choose elements of a contemporary study guide appropriate to a given context.

Outcome 2: Compose guides that maintain consistent structure.

Outcome 3: Apply a range of modern learning strategies to developing study guide content.
1 Introduction

The distinction between distance and presential education is being replaced with the concept of “flexible learning” (Carr-Chellman and Duchastel 2000) where the form of delivery is adapting from the traditional ivory tower model to better meet the needs of the customers. Online technologies provide for effective and dynamic educational styles. A key component is the textual material: the study guide. The guide integrates with other essential elements of the course such as forums for interaction, reference works, and material presented using other media.

Content management technologies offer opportunities to revise the role, nature and format of the study guide. Elements that reflect current teaching strategies can be incorporated in study guides that are not limited to printed paper. Linkages that reveal structure can be generated. The guide can be based around a range of activities, making it suitable for both distance and local students, and present content in a range of modalities.

The application of these concepts is presented within this document: a contemporary study guide for study guides.

Introduction

- Elements/Structure/Components of a course:
  - Learning objectives and outcomes
  - Lecture slides, notes and handouts.
  - Relationships.
  - Reference materials and textbooks.
  - Exercises.
  - Assessment tasks.
  - Diagrams, figures and images.
- Multimedia content.
- Online resources.
- Instructions and learning strategies.
- Online resources, and recent articles.
- Concept summaries.
- ...

- How to manage, collate and maintain?

Approach

- A single study guide.
  - Master document.
  - Contains the material, or directly links to it.

- Elements
  - Interaction
  - Concepts and skills

- Structure
  - Contains internal structure:
    - Relationships within the course content.
    - Learning process from goals to assessment.

- Components
  - Validation - internal consistency checks
  - Concept relationships.
  - Presentation materials.
  - Assessment exercises.

Mechanism

- Inspired by WYSIWYM.

- Content marked up in document processor.
Figure 1: Concepts presented within this guide.

- Content presentation determined by interpretation.
- Typically generate PDF documents:
  - fixed format.
  - interaction through PDF viewer (slide show controls).
- (Home) Custom made.

2 Elements of a study guide

Desirable and widely used teaching activities benefit from being incorporated into the study guide. While presentation of content has always been an element of a study
guide, other desirable aspects of teaching such as developing concepts, promoting interaction and performing assessment can be included as the role and format of the guide develops.

2.1 Interaction

Study guides have traditionally been regarded as static documents supporting learning in isolation - the “teacher in a state of suspended animation” [Rowntree (1994) p. 9]. When combined with distance education the associated lack of interaction between students and staff has been responsible for negative impressions of this form of teaching (Pallor and Pratt, 2003, p. 6). There is strong support for interaction as a key aspect of online teaching (Lynch, 2004, p. 30) (Oliver et al., 2001, p. 106). To paraphrase Pallor and Pratt (2001, p. 152), the best study guide will be ineffective without facilitating interactivity in the course presentation.

Such interactivity needs to be based on the example set by the instructor (Pallor and Pratt, 2003, p. 25). Interaction need not be synchronous but can take place via message drops such as online forums. Textual responses in these forums represent just another variation on the printed material already available. Other forms of interaction are possible through providing other media (video, or content markups), through group collaborations and by providing computer controlled interaction through tests and polls (Pallor and Pratt, 2001, p. 7). Interaction between students is encouraged, for example by getting students to provide feedback on each other’s work (Pallor and Pratt, 2001, p. 35).

An alternative form of desirable interaction is the online community that emerges from a critical mass of interacting people (Pallor and Pratt, 2003, p. 16). A positive class dynamic is difficult to guarantee for all but the most talented teachers. Some suggestions from the study of emergent systems could provide insight into formation of communities. Crucial factors that have been identified include feedback (both positive, for example a reward for contributing value to a discussion, and negative in the form of penalties for detracting from community involvement) (Johnson, 2002, p. 137) and randomness (Johnson, 2002, p. 78) to break the system out of unstable equilibria, for example by injecting fresh discussion points into an online forum.

Interaction can be subtly encouraged through the course activities contained within the study guide.
Elements: Interaction

• Traditional text materials are static.
• Hypertext allows interaction.
  – links provided to external resources.
  – links provide paths through the guide.
• Retain a single self-contained document to depict scope.
• Interaction leads to emergent systems.

3 Communication issues and strategies for MCGs

3.1 Concepts

3.2 Concepts

2.2 Concepts

Supports OUTCOME 1 on page 1
Supports OUTCOME 2 on page 1
Lectures have traditionally been the opportunity to present knowledge and related conceptual models. These are rapidly losing their significance with flexible learning strategies (recorded lectures and online slides) providing students with alternative ways of accessing the knowledge element. Lecture formats can be substantially revised. Allocation of time to lecture sessions can adapt to the nature of the material. In an online space there is no reason to stick with lengths determined predominantly by allocation of lecture venues. Taping conventional lectures is also not a requirement (Palloff and Pratt, 2001, p. 27). As an example, the online lessons provided by the Khan Academy provide material in 12 minute chunks and teach mathematics by presenting concepts in the context of a worked example.

Media, such as study guides, replace the role of the lecturer as provider of the knowledge. This emphasizes the role of the lecture as guide (Lynch, 2004, p. 32) or facilitator (Palloff and Pratt, 2003, p. 7) but places increased demand on the support materials to convey conceptual models. Mechanisms for presenting concepts are discussed in section 4.2 on page 11.

Traditionally study guides are employed to assist in digesting the content provided in textbooks (Lovitt and Horton, 1987, p. 333). They provide an overlay: a succinct structure to the material in the text that matches the course presentation. Lovitt and Horton (1987, p. 335) provide a recipe for preparing guides for slow learners; involving summarizing and organizing the text, extensive cross referencing to the original source, and providing missing word and multiple-choice questions. These guides also double up as lesson plans (Lovitt and Horton, 1987, p. 341). The skills developed in this scaffolded environment are transferrable, allowing students to prepare their own resources in future (Lovitt and Horton, 1987, p. 342). Application of these ideas to providing connections between concepts and other elements of a study guide are described in section 3.1 on the next page.

Elements: Concepts and Skills

- For technical subjects, present:
  - Concepts and related knowledge.
  - Skills, techniques and algorithms.
  - Relationships.

- Concepts and skills presented in the study guide
  - Repackaged directly as lecture notes.
  - Linked to resources provided in alternative formats.

- Relationships:
  - Annotated directly within document.
  - Extracted and presented in various formats.
2.3 Skills

Supports OUTCOME 3 on page 1

Some technical subject areas place emphasis on mastering specific skills. Goal oriented learning is reported as working better for adult learners who prefer having clear objectives stated in the study guide while being given the freedom to satisfy these in a way best suited to their personal context (Pallone and Pratt, 2003, p. 35).

A study guide can be viewed as a form of content enhancement (Sencibaugh, 2008). Suggested approaches, originally intended for students with learning disabilities, emphasize the transfer of skills (rather than content). These include: advanced organizers (the introduction in advance of the lesson), graphic organizers, mnemonics, peer tutoring, and outlines.

2.4 Assessment

Issues arise with assessment when courses are presented in new formats (such as online). The format of traditional assessment tasks (such as exams) may not match the styles developed for the online community (Pallone and Pratt, 2003, p. 94) and the students feel cheated by the change in expectations.

Exercise 1

Identify the elements of the study guide used within this study guide. Draw up a list of the most significant elements. Present your list in the online discussion forum provided. After reading the list presented in other postings, provide a follow-up posting supporting your choices, or reasons for any changes that you would like to make.

- Assesses OUTCOME 1 on page 1

3 Structure in a study guide

Supports OUTCOME 2 on page 1

The relationships between elements within a study guide are a key component in structuring the way in which the material is conveyed. The emphasis in this section is on employing this structure as an aid to developing a course and its associated study guide - rather than manually exposing the structure within already developed materials. This structure must also imaginatively incorporate the various resources and media used for teaching.

3.1 Linkages

The common theme with respect to the development of study guides is structure. The study guide needs to contain a predetermined set of components. Importantly, the relationship between these components needs to be explicit and maintained consistently (Carr-Chellman and Duchastel, 2000, p. 233). Linkages need to exist in:

- Learning: From the learning objectives to the corresponding material and through to the related assessment tasks.

- Concepts: From elements of the course material to external resources, such as textbooks, web sites and other media.
Many of the principles espoused in Deakin’s “Course materials quality standard: Study guides” relate to structures and relationships. These can, and should, be maintained automatically. The value that the teacher can contribute is in providing the relationships. In particular subject experts are most profitably employed in describing the conceptual models that relate to course content. The mechanical process of converting this to various presentation formats can be delegated to entities skilled in this area.

Online learning materials are often dependent on the teaching platform used and restricted by the facilities available (Oliver et al., 2001, p. 106). Since development of these materials is expensive (Oliver et al., 2001, p. 100) sharing these resources would be beneficial, reducing effort required and preventing duplication. While admitting that a plethora of products for content creation already exist (Oliver et al., 2001, p. 101) describe at a very high level the creation of a further toolbox. A noted strength is the ability to customize the resulting material to meet the needs of a particular course.

Separating representation from presentation reflects current practice in computer science. The model-view pattern insists on a separation of the content from the way it is presented. The markup languages that form the core of the world wide web describe the nature of the content. Individual browsers determine its presentation; whether it be for high resolution displays or the tiny screens of mobile devices.

The approach used in preparing this document is to enhance the study guide with additional annotations that allow the study guide and other related components to be generated directly from a single description. This avoids the need to manually maintain consistency between different course materials as the course develops and evolves. It also allows the presentation to be adapted as new presentation techniques prove themselves, and supports alternative modes of presentation that use the same source materials. The links present in the PDF version of the document are derived from this markup.

Structure: Linkages

- Active document:
  - Links provided through markup - provides semantics.

- Paths through the material:
  - Outcomes to content to exercises and assessment.
  - Can validate coverage for each outcome.
  - Can relate content and exercise to outcome.

4 To avoid embarrassing situations, such as when the link that advises on presentation of electronic materials (under 3.4) is itself referring to a missing page.
• Relationships within the material:
  – Cross-references between sections, to figures and bibliography.
  – From bibliography back to content.

References


• Relationships to external resources:
  – URLs, online articles, youtube, wikipedia.

3.2 Diversity

Knowledge representation and presentation is a traditional role of the study guide. Supporting flexible presentation strategies enables different learning styles. Examples of learning styles include those described in terms of senses (e.g. auditory, visual, graphical, or visual textual) or those based on cognitive strategies (e.g. spatial, linguistic, logical) (Palloff and Pratt, 2003, p. 30). Customized study guides could be produced by profiling students and customizing the guide to assumptions derived from these (Rowntree, 1994, p. 41). A more appealing alternative is to present materials in several different ways to accommodate different styles, or to encourage students to employ alternative learning styles.

Issues with incorporating multimedia content and other technologically rich resources in courses result from the limited abilities of teaching staff to provide such materials in sufficient quantities, rather than constraints on the technology (Palloff and Pratt, 2001, p. 10). Preparation time is also limited, particularly where distance education is seen as a way of increasing student numbers without incurring additional cost (Lynch, 2004, p. 31). As such, simplifying the process of including such content is likely to promote its use. Instructor effort can then be devoted to interacting with course participants (an increased load in online courses (Palloff and Pratt, 2001, p. 30)), rather than the mechanics of content preparation.

The diversity of distance education systems (Oliver et al., 2001, p. 101) could also be taken as an indication that different courses have different needs. Standardization promotes uniformity and stifles innovation and sharing (Oliver et al., 2001, p. 108). Even experienced online instructors prefer to use topic specific rather than generic tools (Palloff and Pratt, 2001, p. 76).
A move away from the study guide as a static document is reported with the advent of hypermedia (Boone and Higgins, 1992) where the guide provides direct access to associated concepts and removes linear sequencing. An analogy of hypermedia as a set of transparency overlays (Boone and Higgins, 1992, p. 381) is used. This is distinct from the confusing morass of often outdated links which is my own experience of modern hypertext. The benefits of a hypermedia approach are in allowing each student to determine their own path through the material (Boone and Higgins, 1992, p. 382) and to concentrate on the modalities that best suit their learning styles. A mechanism is discussed in section 4.3 on page 12 for providing an overlay (or an alternate modality) for conveying the content included in this guide.

Structure: Diversity

- Multi-modal presentation
  - Links provide multi-media content.
  - Single document for spatial coherence.
  - Images provided for visual mnemonics.
  - Multiple forms of presentation (guide text, notes, margin annotations).

4 Components of a study guide

Supports OUTCOME 3 on page 1

Providing structure and interaction within a study guide is an admirable goal - but is it feasible in practice? This section describes and demonstrates some of the facilities employed to generate this document and its supporting materials.

4.1 Learning structures

A frequently raised issue is the need to teach students about online learning (Palloff and Pratt, 2003, p. 25), particularly regarding issues such as how to learn in an online context, or how to participate within the course community. This is an aspect that could be explicitly included in a study guide. The alternative is to set exercises that produce the desired behaviour (or cause it to emerge - see section 2.1). Some suggested activities include: “syllabus scavenger hunt” (Palloff and Pratt, 2003, p. 85) or quiz on course objectives. This is supported by my own experience with presenting course details statically: an offer of bonus marks was hidden in the statement of learning outcomes for several years without it ever being taken up.

The learning outcomes themselves have a definite structure, which can be marked up for presentation. At the same time each outcome can be tagged to support linkages from other course materials. Relationships between relevant sections and their corresponding outcomes can be presented explicitly in the study guide. Such references can be used to ensure that all outcomes are covered in some form; both in terms of the material presented and in the assessment tasks that are set. Automatically tracing the links produces a summary similar to that shown in figure 2. This reveals gaps, such as the lack of assessment for outcomes 2 and 3 in the example shown.

4 http://www.deakin.edu.au/itl/dso/strategies-teaching/tips/d2l-writing-il0.php
Audit of Outcomes

| Outcome 1 | 1 |
| Outcome 2 | 1 |
| Outcome 3 | 1 |
| Outcome 1 content provided in Section 2.2 | 6 |
| Outcome 2 content provided in Section 2.2 | 6 |
| Outcome 3 content provided in Section 2.3 | 7 |
| Outcome 1 assessment provided in Section 2.4 | 7 |
| Outcome 2 content provided in Section 3.0 | 7 |
| Outcome 3 content provided in Section 4.0 | 10 |

Figure 2: Auditing the mapping of outcomes in the study guide.

4.2 Concept maps

Concept maps are an example of exploiting marked up content in the form of relationships between concepts covered in the course content. Frequently prescribed as a formative exercise, they also provide a high level overview of the connections present between course components. Personally I find them useful in defining the relevance of each component when assembling a course, and in conveying that relevance to the students. Mind-maps are used for a similar purpose by Rowntree (1994, p. 60). These maps also identify dependency issues where concepts are needed before they are introduced.

A concept link has a standard form: $A \xrightarrow{r} B$, where $A$ and $B$ are concepts and $r$ represents a relationship from $A$ to $B$.

The presentation of a concept link is independent of the way in which it is represented. In the prototype developed for this guide, concept links are presented by:

- Showing them as margin notes in study guide itself, with each link adjacent to the region that discusses it.

- Generating a graphical representation of a portion of the concept map, showing the relationships that exist between concepts. For example, the concept map for this guide is shown in figure 1. This could be included in a slide presentation with the map developing as the lecture progress.

Components: Concept maps

- Mark up the concepts.
- Mark up the relationship between the concepts.
- Profit.
- Benefits:
  - Make explicit the abstraction.
  - Teacher can identify the message.
- Students can identify the message.
- Both can gain fresh insights.
- Result can be shown in several forms.

4.3 Presentations

Presentations (particularly PowerPoint) is becoming an increasingly mandatory part of a course. Students have come to expect them and rely on them as an alternative to active note taking and as a concise source of study material. The role of the study guide has been usurped in the process. However, given Hazards “death by PowerPoint” present in many presentations, it is time to reclaim the content for the study guide while still providing interesting and stimulating presentations.

A recent Internet based presentation [5] provides concepts online without resorting to bullet points. Instead a sequence of relevant images are used to visually represent the material. Similar inspirational presentations are provided at the TED conferences [6] whose videos, despite containing educational content, have been observed to be downloaded and viewed by students for pleasure.

These examples form the basis for generating interesting presentations, derived from points provided within the study guide. Using techniques from research into text-to-scene translation (Glass et al., 2007, p. 138) key terms can be automatically translated into images by using the phrases as search terms for Google’s image search. Presentations derived from the study guide can also potentially use text and images taken directly from study guide content.

Taking inspiration from the use of cartoons to provide a friendlier approach to study materials [7] the theme of the images provided can be customized by adding extra search terms - such as “cartoon” to provide amusing illustrations of key concepts. Slides generated using a range of themes are shown in figure 13.

In keeping with the theme of generating multiple modalities, the points used in the presentation are also included in the text of the study guide.

Components: Presentation

- Key points marked up in document.

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Figure 3: Generated slides with different themes.

(a) Theme: “funny”.

(b) Theme: “computer”.

“This PowerPoint slide has a dynamic layout comparing reading scores throughout the district, which you would have seen if I remembered to bring a spare projection bulb.”
• Form the basis for lecture notes.

• Form the basis for presentation slides.

• Death by PowerPoint.

  – Rather voice over visual.

  
  ![RSA Animate - Drive: The surprising truth about ..](http://www.youtube.com/watch?v=u6XAPnuFjJc&feature=player_embedded#)

• Visual:

  – Translate words into images (automatically).

  – Provide visual interest and reference.

  – Include a theme.

  – Introduce variation.

“Presentation” - funny
“Presentation” - computer

“Presentation” - cartoon
4.4 Assessment

Assessment requires action on the part of the student and hence can be used to manage interaction (section 2.1 on page 4). Discussion fora are a common facility employed to encourage interaction, and provide material that may be assessed. Seeding of the discussion by the teacher reduces the entry hurdle for student contributions (Palmer et al., 2008, p. 852). In my experience initial participation by virtual students (fictional student accounts managed by the teacher) is effective in getting the flock to start moving in a particular direction. The value of this interaction is further demonstrated with evidence of a correlation between level of active contribution and final assessed mark (Palmer et al., 2008, p. 856).

Assessment using these interaction facilities can also be conducted at a “meta” level. A recent exercise required students to set their own assessment tasks: essentially submit their own problem exercises to a discussion board and answer two of the tasks set by others. Participation levels were good - although the class dynamic in general was particularly good for that group. This activity provides benefit to the student in the form of a variety of sample problems with the opportunity to see the solution strategies employed by their peers. Feedback is available by comparing the alternative solutions submitted (with teacher intervention when misconceptions are propagated). This task proves useful for assessment: the quality of the question and accuracy of the answers can be used for this purpose. Surrupitious collusion is reduced because of the public nature of the task. The process also provides feedback to the teaching staff regarding the expectations of the students about the nature and level of assessment expected for each topic in the course.

Online interaction places emphasis on a single modality: written communication. This may be an obstacle for students studying in a foreign language who are faced with seeing their limitations exposed in public for the duration of the course. Even the mechanical processes can be a hurdle - with students struggling to express complex technical notation or graphical structures.
Components: Assessment

- Active content incorporates programs into document.
- Code provide to set and solve problems.
  - Generates variety.
- Mechanical versus conceptual element of problem solving.

Experience

- Marking up content encourages:
  - abstraction.
  - structure and relationships.
  - consistency.
  - making change in only one place.
- Separation of content and presentation:
  - allows alternative presentations (guide, slides, styles, ...).
  - simplifies change of style.
  - reduces pressure to top-dress.
- Generated documents:
  - create dynamic content (living documents).
  - reduce load in refining presentation.
  - injects variety from external sources.

5 Conclusion

It is no longer adequate to assume the model of the study guide as a set of paper notes to be distributed to the class at the start of a course. Technologies used in teaching make it possible for the study guide to be the driving force in the course; allowing the lecturer to concentrate on supporting learning activities. Mechanisms that encourage interaction are components of modern study guides; encouraging engagement with the concepts and skills provided within the course.

The organization of study guide structures the elements of the course, from objectives through to assessment. The structure of the guide also links the materials used in the course, particularly where these span multiple media and modalities.

Technology can further assist in providing a coherent picture of all the elements used in a course. Tools provide ways to relate structure, concepts, presentation and assessment tasks to the master document for the course: the study guide.

Conclusions

- Keep(s) everything in one place.
- Explicitly annotating structure is good for student, teacher and unit.
- Slide creation is no longer a primary function.
- Active document but also a living one.
References


