Abstract:
The building of web content for students at the high school level needs to be well structured to ensure quality. The structuring takes place through a decomposition process. This decomposition occurs at the topic/lesson level during which instructional materials are built for each topic according to a template consisting of six components - Review, Focus, Estimated Completion Time, Objectives, Presentation of Content, and Assessment. The template provides a layout to be used as a standard so that instructors can quickly become familiar with the steps and processes necessary for structuring course materials. The template or framework provides a means whereby the learner is encouraged to remain focused on the topic at hand. For example, the Presentation of Content does not include the detailed instructional materials for the lesson but only highlights the main points. A link on that page gives access to the detailed instructional materials. With the development of each topic the Web course will eventually become self-contained in that it will contain all the required content and, as such, a textbook will only be used only as supplementary reading. The components of the topic/lesson framework are described in this paper.

1. Introduction
In this paper we present a topic/lesson design template. This template was designed for instructors / teachers of students in Caribbean high schools who are involved in developing e-courses that must cover a set curriculum. Such courses designed for young learners should be well structured so as to ensure sound pedagogy. In our approach, this structuring takes place through a decomposition process, where the curriculum content is first decomposed into a small number of high-level topics (syllabus). These are further decomposed into individual lessons. The template/framework can be used to build individual lessons which are intended to be delivered in a classroom/lab setting under the guidance of a teacher in the role of facilitator. Each lesson is designed to be of a fixed duration, for example to fit into the school timetable. The Web course developed as a result of the development of each topic is self-contained in that it contains all the required content and, as such, a textbook is used only as supplementary reading. This design template was used in the design of a course on Information Technology for high schools students across the Caribbean region.

2. The Lesson Framework
The framework for developing individual lessons consists of six components - Review, Focus, Estimated Completion Time, Objectives, Presentation of Content, and Assessment. These components are described below. In the design of the lesson page, the instructional designer should attempt to display all the components listed below on a single page so that this page becomes ‘the lesson at a glance’.
2.1 Review of previous lesson
The review section of the template is useful in that it connects the current lesson to the previous lesson and is used as a road map indicating to the students exactly where they are at present. This review may be teacher led. The review may include any or combination of the following, except ‘none’:

- None – this may be appropriate for the first lesson of each unit.
- A five minutes discussion on key concepts of the previous lesson.
- Asking students to write one important thing learnt from the previous lesson.
- Asking students to write one thing they had problem understanding from the previous lesson.

This list of review activities is not exhaustive; for any given lesson, the instructional designer can decide what is the most appropriate way to review the previous lesson.

2.2 Lesson Focus
This component of the framework gives a brief overview of what is covered in the current lesson. The lesson’s topic for a particular unit (module) is taken from the structure derived in the modeling process.

2.3 Estimated Completion Time
This states the approximate amount of time needed to complete the lesson on a topic. Because the course is designed to cater for the different learning styles of participants the time taken may vary within some range. However, it is a useful guide to teacher and student and not meant to be followed rigidly.

2.4 Lesson Objectives
Learning objectives should be clearly stated up front. The objective(s) listed in this section is based on the topic in the Lesson Focus section and should contribute to the objective(s) stated in the corresponding Unit Focus.

2.5 Presentation of Content
This section highlights the main points of the content and provides a link to detailed information document. The highlights allow students to read and understand the lesson at a high level before getting into the details. Highlights may include, for example, a worked example of a problem to motivate students. Each detailed information document entry is designed to have an associated main page entry. Instructions for activating the linked Web page document should be provided. The linked document contains the materials for the lesson’s topic.

All relevant topic materials developed should be kept small so as to keep reading online to a minimum. If materials are too lengthy the students may be instructed to print them instead of viewing onscreen. Some of the drawbacks of lengthy materials as stated in [1] are as follows:

- Most learners don’t like to read large amounts of text on a computer screen.
- Many learners enhance their learning and recall, and improve their review capacity, by underlining and annotating important items.
- Most learners do not have access to this type of annotation tool on their screen.
The content lesson can be presented in many forms; it may be a static document that the learner must read and understand or it may be interactive content which allows the learner to actively participate in his own learning.

2.6 Lesson Assessment
Assessment contains exercises/activities aimed at evaluating whether the lesson’s objective(s) have been met or not, and to provide feedback. Formative assessment may be in the form of activities which reinforce learning. Instructions for completing the exercises should be clearly stated. Given the young age group that is the intended learner group, assessment for a lesson should have multiple assignment activities. Some may be online while others may be offline activities. Activities, naturally, should be appropriate to the lesson type. In section 3, we examine some categories of lessons and related assessment. When students click the assessment link on the lesson page, this should bring up a list of assignment activities which the student must complete. Along with each assignment there is a container for storing students’ submissions (for example, a drop box), (see Figure 1). Many Learning Management Systems have an Assessment Manager tool to create, grade and manage summative assessment for the course.

![Assessment ERD](image)

Figure 1. Assessment ERD

3. Building different categories of learning content/assessment

During our research work with the Information Technology syllabus for high schools in the Caribbean we have discovered three types of design approaches – (i) Concept based learning, (ii) Skill based learning, and (iii) Problem based learning [2]. The unit sections/modules could generally be categorized as one of the above three categories. The delivery of the content and the corresponding assessment varied according to the category of the unit.

3.1 Concept based learning
Several units/modules of the course could be categorized as concept based learning. These units present theoretical concepts, definition and explanation of terms, understanding how things work, and various types of application domains. Students are expected to read, understand, visualize, memorize, and internalize the concepts presented. The content was presented using the full range of multimedia, where appropriate; for example some concepts can be better taught using animation (with audio). Assessment activities for these types of units included quizzes, matching components with their function, crossword puzzles, and short answer offline activities. All online activities emphasized feedback to the students on the answers they supply so as to correct or encourage students. The computer in these cases can be thought of as a tutor.

3.2 Skill based learning
Skill based learning units attempt to impart a skill to students. In the IT course, these units focused on building expertise in the use of Office Productivity tools, namely word processing, spreadsheets, presentation and database management software. The content for these units was decomposed into short tasks and presented visually as a ‘how to’ lesson. We made good use of
short video clips to illustrate how to complete a task. Assessment activities for these units included actually completing assigned tasks. For example, Database management exercises - students will have to use the database management software and become familiar with the features being tested in order to complete exercises, for example: create tables or perform queries. For this type of activities the computer is used as a tool.

3.3 Problem based learning
Some of the units in the course could be categorized as problem based learning, for example algorithm development and computer programming. The approach taken for these units was to use visualization to teach programming [7]. Concepts are taught using real world examples that the young students can identify with; in this way some of the problems related to understanding abstract concepts are alleviated and learning occurs in context. The full range of multimedia technology including animation, sound and video are used to immerse the student in an environment where learning is fun and visual display of the concepts reinforce learning. A gaming theme is used for formative assessment. Students are provided with ‘game’ activities such as “spot the error”, “predict the output” and “put in order”. These enhance critical thinking. They test comprehension and knowledge as well as higher order thinking skills. Students would have to use the programming software and become familiar with the features being tested in order to complete these exercises:

- Students are given the code for the solution of a programming problem. They are required to copy and paste the program code into an appropriate editor and then run.
- Students are given a problem statement and segments of code. They are asked to supply the missing code and then run.
- To test for proper documentation within program students are asked to strip their programs off the code leaving only the documentation. Students are then asked to build code from the program documentation.

During these exercises the computer is used as a trainee.

4. Putting the template to work
An example illustrating the use of the template in developing instructional materials for problem based learning is presented below.

4.1 Problem based learning
Figure 2 shows how the template works for problem based learning units. The problem based learning units are concerned with the application and use of knowledge to solve problems, for example computer programming. In such situations the computer is used as a trainee because the students are directing the computer instead of being taught by it. For example, the computer can be instructed to display all the odd numbers from 1 to 20.
**Figure 2 Template showing a Problem based learning example**

**Link:** Pseudocode

**Review:**
Discuss for about 10 minutes the topic on algorithms and flowcharts.

**Focus:**
Topic to be studied in this lesson:
Pseudocode

**Estimated Completion Time:**
40 minutes

**Objectives:**
Upon Completion of this lesson you should be able to:
develop pseudocode algorithms to solve simple problems.

**Presentation of Content:**
Pseudocode is a structured technique that uses English-like statements in place of the flowchart's graphic symbols. Pseudocode looks more like a program than a flowchart.

To access the material for this lesson **Click on the link at the top/bottom of the Web page.**

**Assessment:**
To complete the following exercises, first click the Assessment link then the appropriate assignment link. When you are finished click the Answer Container link to enter your answers.

1. Write a pseudocode algorithm to print all even numbers from 1 to 20.

4.1.1 The Pseudocode link.

**Pseudocode** is a structured technique that uses English-like statements in place of the flowchart's graphic symbols. Pseudocode looks more like a program than a flowchart. Let's consider the sample pseudocode provided below which is used to solve the problem given below.

**The problem** - Write a pseudocode algorithm to print all the odd numbers from 1 to 20.

**Approach:**
Student, you are required to list all the odd numbers from 1 to 20. What is the first odd number listed? What is the second? What is the third? What is the difference between the second and the first, and the third and the second?
The pseudocode is presented below.

_The Pseudocode -_

Number = 1
WHILE number < 21
    Print number
    Number = number + 2
End While
STOP

The keyword STOP is often used to end pseudocode. No standard rules exist for writing pseudocode.

Additionally, flowcharts can be presented to students and asked them to describe the situation that it represents as a pseudocode solution.

Curtis [3] stated that many items with similar or related attributes can be brought together conceptually to form a unique item. This is made possible in chunking. For instance, some programmers based on their experience are able to build larger chunk based on solution patterns which they would have discovered during solving problems.

4.2. Presenting the e-course
Usability and presentation issues are of critical importance. One of the first concerns of the developer is to design effective, user-friendly screens. Thus the interface for this course has been designed to provide maximum effectiveness. The look and feel of the interface is consistent from one screen to the next. For example, the template used for building topic/lesson shows consistency from one lesson to the next. Additionally, screens need to be designed with the appropriate amount of content. Navigational buttons and instructions are in the same place for each lesson. For example, _Next lesson_ button is placed at the end of each Web lesson. In many cases navigation may be built into the Learning Management System being used.

The use of color, text effects, and graphics are used effectively where appropriate in the presentation of the course. The developer is alert to the fact that in many schools in the Caribbean, the low bandwidth and slow Internet connections limit the use of graphics and animation. In the IT content developed, a Launch button in the lesson provides for seamless navigation that allows students to move from a page in the web course to a productivity tool or programming language without opening or closing individual applications.
The Main page is like a road map for the web content and consists of number of links. The links may contain information and/or links to assignments, quizzes, and surveys in other parts of the course. The participants begin working with the course content by opening the Main Web page and then clicking the appropriate links. To move from topic to topic the participants are required to use the Next lesson and Previous lesson buttons.

5. Conclusion
Presenting Web content to high school students requires a high degree of structure due to their maturity level. Such students will be able to work with the material along with guidance from the teacher.

The template presented is a great tool for the high school teacher when developing online content. Not only can it be used by high school teachers but can be adapted for use by teacher of more mature age group students.

Bibliography


