

DEVELOPING E-LEARNING COURSEWARE THROUGH PROTOTYPING
TO ACHIEVE SUSTAINABLE DEVELOPMENT IN HIGHER EDUCATION:
SOME CONCEPTUAL AND PEDAGOGICAL PRINCIPLES

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Abstract

In the recent time, achieving sustainable development and excellence in higher education is anchored on effective development of courseware and its application in a web-enabled environment. The development of interactive e-learning courseware has focused largely on the instructional design approach of multimedia applications and has brought about a substantial amount of success in producing engaging multimedia educational resources. However, challenges associated with early stages of e-learning courseware development are significant when compared to those at the later stages. Addressing these challenges requires sensitivity to the process dynamics, besides the technical know-how. This paper is based on an in-progress project to develop courseware material for online learning. The project is carried by Centre for Research and Development, University of Ilorin, Nigeria in conjunction with all the academic staff of the University. In this project, prototyping is adopted as the developmental model to navigate the project through the early challenges, with the intention of securing incremental small-step successes. Within this developmental model, the paper then describes the intricacies of integrating instructional design principles and evaluation techniques to tackle the challenges of the evolving prototypes. This paper represents the reflections of the author as practicing instructional designer, and it should interest readers who want to see a stronger connection between the theory and practice of courseware development. The general reader may also find the concept of prototyping helpful, given the constant demand to innovate in the learning contexts, and may well find some applicability for it in their own contexts.

Keywords: courseware development, instructional design, prototyping, multimedia

Introduction

The University of Ilorin, as a centre of excellence in higher education, adopts multiple approaches to promote the adoption of online teaching-learning, and to promote its quality. Joint courseware development in the University is one of the approaches. The scope of the project described in this paper is to re-design and develop 15 weeks of lectures in a computer education subject into self-instructional material to be deployed online. The project is part of a larger research initiative by the University to promote self-driven learning among the students through alternative delivery methods, media, and instructional strategies. With the deployment of the self-instructional material online, the overall delivery

of the subject will be blended, with face-to-face still remaining as the delivery mode for tutorials and laboratory sessions. The project will be managed in three phases over 12 months. This paper covers Phase 1, which was concluded successfully recently through University-wide seminar on courseware development. It describes the development and the use of the prototypes to engage the first set of stakeholders, i.e. the course lecturers, curriculum experts, educational technologists, Information Technology (IT) officers and staff members of the subject. In Phase 2, which is in-progress, the prototypes will be substantially expanded and they will be used to engage the next set of stakeholders, the students. With the early challenges resolved in Phase 1 and 2, the project is expected to proceed speedily to completion in Phase 3 and be deployed to the University website for student's open access. The primary criteria for success of the project will be improved engagement of the students with the online self-instructional material, compared to existing lecture participation. Indirect benefits expected are better achievement in the semester examinations, and also greater flexibility in subject deployment.

Statement of the Problem

When faced with a request for assistance with instructional development, a needs assessment is usually carried out with the intention to find answers with respect to the optimal performance, actual performance, feelings, cause(s), and the solutions (Rossett, 1995, Soo & Liew, 2007). However in the context of University of Ilorin, the schools typically approach the University's Centre for Research and Development with the needs established, though not necessarily in a complete and documented format. The Centre for Research and Development will clarify the needs, then focuses on identifying the issues in carrying out the solutions. In this project, the key issues identified were:

- High impact: The project is high impact because of the large number of end users involved (expected to be about 20,000 students). The project was also initiated from the management of the University of Ilorin, thereby increasing its stake significantly.
- High design and development effort is anticipated: The 15 week of self-instructional material to be developed by course lecturers in all the university courses as reflected in the University of Ilorin Academic Programmes. This reduces the possibility of the use of off-the-shelf material. The subject matter of the lectures is technical and largely content-driven. The objectives correspond mainly to the comprehension and application levels of Bloom's Taxonomy of learning outcomes. This means creative instructional design is required to give the material the level of

to engage the students. It follows then that the use of a more sophisticated authoring tool, e.g. Flash, is more likely, instead of rapid development tools such as Adobe Presenter (Breeze).

- A well-defined courseware development team: As online learning is not the predominant form of learning in the university, there is special financial commitment and full spectrum of expertise required for major courseware development for online delivery. Workshops and seminars were usually undertaken by the course lecturers through the experts from university's Centre for Research and Development.
- Lack of experience in the use of self-instructional material among the staff members: While the University is achieving some success in implementing self-instructional online learning, the experience is restricted to highly computer literate lecturers. However, 98 percent of all academic staffs of the university are equipped with laptop computers; the concept of self-instructional material is fuzzy to many. It is reasonable to say that, generally, staff members do not see the distinction clearly between self instructional and informational material in online learning. Although this is an issue that has to be addressed, it also provides an indirect opportunity for the University of Ilorin to engage in staff development in the use of a more sophisticated authoring tool for online delivery.

Strategies to address the problems

After the key issues were identified, strategies were put in place to deal with them. These strategies are helpful to guide decisions on project management and the development model. The following strategies were adopted:

- Proposal was initiated by the University Centre for Research and Development and it was endorsed by the University administration. Seminars were planned and papers presentations were made by experts. Following the paper presentations, workshops were also organized to further help the course lecturers on design modalities and presentation prototype.
- Assigned more resources from experts from other universities to complement the University's Research and Development Centre. This will help to level-up the skill-sets required for the project success. The necessary skill-sets are: project management, subject matter expertise, instructional design, graphic design, multimedia authoring, and quality control. With the Center for Research and

Development providing for the initial project management, a full team of experts is then needed to equipped course lecturers with the necessary skills in creating instructional design, graphic design, and multimedia authoring systems.

- Aimed for sustainable success by breaking the project into three phases. The use of prototypes in Phase 1 and

Pedagogical principles for instructional design

An indirect challenge in this project is to help course lecturers to move from perceiving self instructional material as content presentation to that of engaging the learners with the content instead. To achieve this, three instructional design principles are clearly illustrated in the prototypes. They are: instructional alignment, Gagne's events of learning (Gagne, Briggs & Wager, 1992) and Keller's ARCS model for motivation (Keller, 1983).

Instructional alignment refers to the alignment of the learning objectives, content, instructional strategies and assessment. The objectives, which should be measurably defined, serve as the starting point. The objectives are then used to determine suitable content, instructional strategies and assessment methods. This principle of alignment is central to the design of any instructional material.

Based on a cognitive model for learning, Gagne termed instruction as a set of events external to the learner designed to support the internal processing of the learning (Gagne, 1977, 1985). This set of events is commonly referred to as the nine events of Gagne, they are: gaining attention, informing learners of the objective, stimulating recall of prerequisite learning, presenting the stimulus material, providing learning guidance, eliciting the performance, providing feedback about the performance correctness, assessing the performance and enhancing retention and transfer (Gagne, Briggs & Wager, 1992). With the exceptions of "recall prerequisites" and "transfer learning", which may or may not be evident, all the other events are designed into the self-instructional material. Incorporating the events help to enhance the self instructional capacity of the material, besides improving the richness of the learning experience (Soo & Liew, 2007).

Evolution of the Prototype template

In providing guidance to the course lecturers, a prototype adopted by the University is presented for use as template, reflecting micro-strategies appropriate of contents to be delivered.

Table 1 illustrates the content of the prototype template adopted in phase 1 of courseware development project of the university. This was done through workshops & seminars.

Table 1
Prototype Template adopted at the University of Ilorin

a	Course code, Course Title(number of credits and status in brackets) Duration of course in hours and weeks (maximum of 15 weeks)
b	Lecturer's name and title
c	Qualifications
d	e-mail addresses (Unilorin and yahoo/Gmail)
e	Office location
f	Consultation hours
g	Course Content
h	Course description
i	Course justification
j	Course objectives
k	Course requirements
l	Methods of grading
m	Course delivery strategies and practical schedules
n	Lecture notes <ul style="list-style-type: none"> • 15 weeks of lecture - one topic per week • Objectives of the topics • Description of topics • Topics broken down either by itemization or in prose but they must be linked • Assignments/study questions for each topic • Reading list for each topic

After the prototype template was developed, helpful strategies were put in place to guide the course lecturers on project management and the development model. The following strategies were adopted:

- (a) There should be at least 5 study questions for each week.

- (b) The last week will be the revision week, in which many study questions that cover the whole course would be provided to students. The study questions for the revision week should not be less than 10.
- (c) For each item in the reading list, the exact pages to be consulted by the students must be stated.
- (d) Lecturers for each course must indicate the availability of each item in the reading list. It could be available on the Internet, the University library, the departmental library or even the personal collection of the lecturer.

A general reading list that covers the whole course must be provided. Table 2 shows an example of how a prototype template is further build up from an early development in Phase 1. It then evolves into a more sophisticated prototype and was used to engage the course lecturers in developing their courses using the prototype. The sample given in table 2 is on a course in Educational Technology programme titled: EDT 410, Computer in Education II course. For the purpose of this paper, the courseware is presented up to week 4. This is the Phase 2 stage of the courseware development project.

Table 2: Prototype template on Computer in Education II (EDT 410)

Course: EDT 410 – COMPUTER EDUCATION II (2 Credit Compulsory)	
Lecturer: ONASANYA Samuel Adebisi	
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Office Location: – Department of Science Education Building, University of Ilorin	
Consultation Hours: 2- 3.30pm Tuesdays & Thursdays.	
Course	Introduction to computer/Information Communication Technology (ICT) and its
Content:	applications in education; data representations in computer education; software

	<p>applications in education. Introduction to conceptual pedagogy in integrating technology in e-learning environments, problems and prospects of computer education in Nigerian educational system 30h (T) 60h (P) C.</p>
<p>Course Description:</p>	<p>The course is designed to introduce students in the Educational Technology programme to the tenets of Information and Communication Technology and how it can be applied to develop instructional materials in e-learning environments. Students would be exposed to System flowcharting as carriers of data and information, forms and document flowcharts in organization as needs dictates, like the preparation of data Flow Diagrams (DFDs), follows a convention governing the use of symbols. For example, the rectangle indicates a major processing function; the triangle represents off-line storage; and the open-sided rectangle with dotted lines is used for annotation. The course will also introduce educational technology students to the principles and conceptual methodology of integrating technology into instructional e-learning design. Students will be introduced to different models of technology integration and how these models can be applied to package e-learning instructional materials. Students will have practical experiences in instructional software packaging with text, voice, graphics and video data into CDs and DVDs using instructional models and digital format. This experience will lead students into design and production of instructional e-learning materials using programs such as PowerPoint, HTML etc, into CDs and VCDs. Students will also have practical experiences of CDs and DVDs package design. Innovations in teaching and learning using the process of Information and Communication Technology (ict) in education will be taught. The course also describes the concept of feasible application of microcomputer in the Nigerian classroom for teaching and learning. Some of the potentials of ICTs, for classroom application will also be discussed. These include Computer brVCDs 6tcl 0 T c (I</p>
<p>Course Justification:</p>	

	<p>instructional e-learning resources using ICTs. This is to ensure that they participate fully in the world of the contemporary education technology and to accomplish their everyday task. Teachers at all levels of education are usually involved basically in two things: teaching and research, with auxiliary administrative assignments. ICTs have the potentials of not only ensuring effectiveness and efficiency in these two areas (teaching and learning); they have the potentials of easing the administrative duties. The theoretical and practical knowledge acquired from this course will enable the students to develop onto more detailed and advanced instructional packaging converting information (text), images, sound, motion, and so on into digital format.</p>											
<p>Course Objectives:</p>	<p>The general objective of the course as an integral part of the B. Ed (Educational Technology) is to produce graduates in Educational Technology who will be competent to provide support services in the area of instructional materials for practicing teachers at all levels of education.</p> <p>At the end of the course, the students will be able to:</p> <ul style="list-style-type: none"> • identify the components of System flowcharting and its application in organizational and instructional systems, • describe conceptual models of integrating technology into instructional e-learning in multimedia environments, • describe software applications (e.g) PowerPoint and Html in instructional design, • describe and explain the problems and prospects of ICT in Nigerian educational system, • Produce instructional e-learning packages into CDs and VCDs using at least the PowerPoint. 											
<p>Course Requirements:</p>	<p>Ⓜ This is a compulsory course for all students studying Educational Technology. In view of this, students are expected to participate in all the course activities, including the practical and have minimum of 75% attendance to be able to write the final examination.</p> <p>Ⓜ Practical production of digital e-learning instructional package design will be conducted by the students</p> <p>Ⓜ They will also be expected to treat the study questions and assignments. Students are also expected to have e-mail accounts.</p>											
<p>Methods of grading:</p>	<table border="1"> <thead> <tr> <th data-bbox="408 1848 750 1883">No</th> <th data-bbox="756 1848 1098 1883">Item</th> <th data-bbox="1098 1848 1436 1883">Score %</th> </tr> </thead> <tbody> <tr> <td data-bbox="408 1892 756 1928">1.</td> <td data-bbox="756 1892 1098 1928">Practical</td> <td data-bbox="1098 1892 1436 1928">30</td> </tr> <tr> <td data-bbox="408 1937 756 1964">2.</td> <td data-bbox="756 1937 1098 1964">Class assignments/ test</td> <td data-bbox="1098 1937 1436 1964">10</td> </tr> </tbody> </table>	No	Item	Score %	1.	Practical	30	2.	Class assignments/ test	10		
No	Item	Score %										
1.	Practical	30										
2.	Class assignments/ test	10										

		Comprehensive examination Total	final 60 100
Course Delivery Strategies:	<p>The lecture will be delivered through face-to-face method, theoretical material, e-materials (lecture note) provided during lecture and practical studio sessions.</p> <p>Students will be encouraged and required to read around the topics and follow current issues in the media. Web-interactions will be employed by requesting each student to have yahoo e-mail address to enable them participate in the yahoo discussion group that had been created for the course (unilorin/afs201). Additional materials and links will be provided on the board. The delivery strategies will also be supported by tutorial sessions and review of study questions.</p>		
Practical Schedule:	<ul style="list-style-type: none"> ⦿ The practical session involves introduction computer/ICT studio to the students and the various equipment available for production of instructional e-resources ⦿ Several software applications for designing and producing instructional e-resources will be explained, for example, PowerPoint, Html, Macromedia and students will be required to produce samples of digital instructional materials on CDs and DVDs. <p>The practical will be conducted as follow:</p> <ul style="list-style-type: none"> - Introduction to computer, ICT studio and laboratories. • Rules and precautions to be taken in computer / ICT studio and laboratories. • Introduction to computer and ICT tools for designing instructional e-resources • Introduction to Microsoft Word application. • Introduction to PowerPoint Software application and their uses • Introduction to Html and Macromedia applications in e-learning instructional design. • Introduction to Html and Macromedia applications in e-learning instructional design contd. • Introduction to voice synthesis, fine-tuning, microphones, and recordings into digital e-learning programs • Introduction to voice synthesis, fine-tuning, microphones, and recordings into digital e-learning programs contd. • Designing and packaging e-resources into CDs and DVDs • Introduction to Internet educational materials sourcing. • Adaptation and Editing of e-learning materials • Introduction to copyright issues on Internet and other digital resources 		

Reading List:	<p>Brightman, W. & Dimsdale M. (1986). <i>Using computers in an information age</i>. New York: Delmar Publishers Inc. Pp 85-114, 343-371, 435-489)</p> <p>Roblyer M. D. (2004), <i>2004 Update integrating educational technology into teaching. Third Edition</i>. Columbus, Ohio: Prentice Hall. Pp E1-E61</p> <p>Onasanya S. A. & Adegbija M. V. (2007) <i>Practical Handbook on Instructional Media</i>. Ilorin, Graphcom Publishers (Second Edition)</p> <p>Onasanya, S.A. (2001). Computer in Education. In I.O. Abimbola (Ed). <i>Fundamental Principle & Practice of Instruction</i>, Ilorin: Department of Curriculum Studies and Educational Technology, University of Ilorin, Ilorin.</p> <p>Onasanya, S. A, Olumorin C. O., Asuquo E. N. & Agunjemite G. B. (2007) Instructional Computer Technology: Implications for Gender achievement in Nigeria. <i>Information Technology Journal</i> 6 (7) 1063-1068 (Downloadable at http://www.ansijournals.com/itj/2007/1063-1068.pdf)</p> <p>Onasanya, S. A & Asuquo, E. N. (2007)., S.cho,</p>
Week 1:	
Objective:	
Description:	

	Make a list of about 20 relevant journals and text to the course.
Week 3:	Topic: System Flowcharting and Data Representations in Education
Objective:	At the end of the lecture, students should be able to: <ul style="list-style-type: none"> (i) identify and describe the components of System flowcharting and its application in organizational and instructional systems, (ii) construct organizational systems using the flowcharting system.
Description:	System flowcharting as carriers of data and information, forms and document flowcharts in organization, like the preparation of Data Flow Diagrams (DFDs), a convention governing the use of symbols. For example, the rectangle indicates a major processing function; the triangle represents off-line storage; and the open-sided rectangle with dotted lines is used for annotation. System Design approaches.
Study Questions	<ol style="list-style-type: none"> 1. Identify four imperatives for system change. 2. What are the three phases of system development? 3. Which analysis tool shows how data flows in a system? 4. Which analysis tool shows how paper flows in a system? 5. List and explain four approaches of a system design
Reading List:	<p>Brightman, W. & Dimsdale M. (1986). <i>Using computers in an information age</i>. New York: Delmar Publishers Inc. Pp 85-114, 343-371, 435-489)</p> <p>Roblyer M. D. (2004), <i>2004 Update integrating educational technology into teaching. Third Edition</i>. Columbus, Ohio: Prentice Hall. Pp E1-E61</p> <p>Heinich, R.; Molenda, M; Russell, 3. & Smaldino, S. <i>Instructional media and technologies for learning, Seventh Edition</i>, Columbus, Ohio: Prentice Hall. Chapters 9-11</p> <p>Some relevant sites include:</p> <ul style="list-style-type: none"> (i) www.SmartDraw.com (ii) www.editlib.orQ/d/12737/proceedina 12737.pdf
Week 4:	Topic: Computer Software Application - Microsoft Word
Objective:	The objective of the week lecture is for the student to be able to: <ul style="list-style-type: none"> (i) explain types and functions of Word processing systems. (ii) describe the input and output for word processing systems
Description:	Writing, whether it is technical expository, business communication, news reporting, or creative writing, is ten percent expressing ideas and ninety percent editing to

	make them readable and understandable. Microsoft word will be discussed as the manipulation, by machine, of characters, words, sentences, paragraphs, and documents to serve communication purpose. Growth of word processing and working with a word processor will be discussed.
Study questions:	<ol style="list-style-type: none"> 1. What is the primary advantage of word processing? 2. What is the difference between a stand-alone word processor and a
Assignments:	<ol style="list-style-type: none"> 3. What technique is used to minimize none-electric storage techniques in a word processing environment? 4. List and describe three supplementary programmes that make word processing more productive 5. Will word processing take the 'creative' out of creative writing? Discuss <ol style="list-style-type: none"> 1 Compare and contrast the strengths and weaknesses of floppy diskette versus hard disk storage in a word processing environment 2. Discuss the issues to be considered when deciding to buy word processing equipment for business.
Reading List:	<p>Brightman, W. & Dimsdale M. (1986). <i>Using computers in an information age</i>. New York: Delmar Publishers Inc. Pp 343-371</p> <p>Heinich, R.; Molenda, M; Russell, J. & Smaldino, S. <i>Instructional media and technologies for learning, Seventh Edition</i>, Columbus, Ohio: Prentice Hall. Chapters 9-11</p>

As the prototypes evolve, decisions on retaining or discarding them have to be made. To retain means to carry over the prototype or some of its elements over to the next phase, and usually the new prototype will show a web-enabled design. This may look completely new form the Phase 2 for it is th2 r Tc(o) Tj0 Tc(g) T113.445 7w0.381 Tc(o) Tj0 Tc(g) Tj0.812 Tw0.245Tc(Thi) Tj0 Tc(s)5Tj6.856 Tw0.511 Tcc(o)

Figure 1 shows an example of how a prototype should transform into at a later development in Phase 3. It then evolved into a more sophisticated prototype and was used to engage the staff members of the subject.

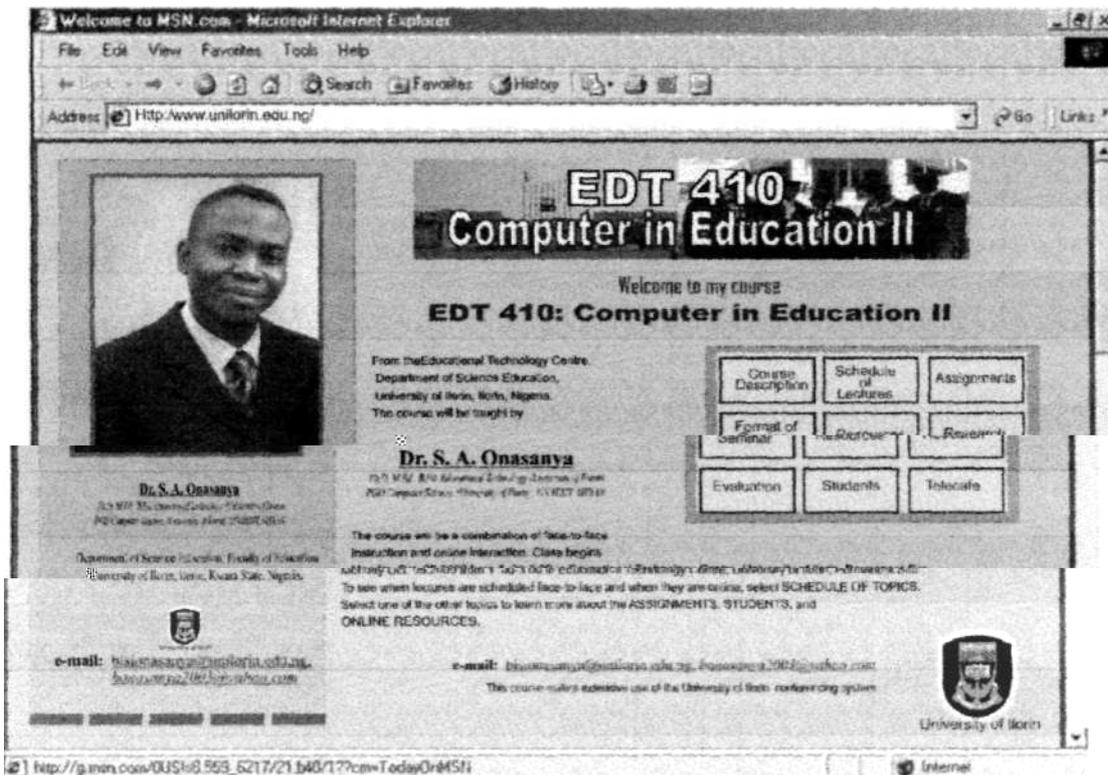


Figure 1. Dr. Onasanya's class home page (A simulated model)

Formative evaluation is done with the intent to improve (Scriven, 1991), and therefore lies at the heart of prototyping. In an analysis of various rapid prototyping models evolved from demonstration projects, Jones and Richey (2000) noted that rapid prototyping de-emphasizes summative evaluation but stresses formative evaluation. However, it should be kept clearly in mind that prototypes are only a means to an end. Although the emphasis is on formative evaluation, they should be planned with the view that the final material stands a better chance of undergoing a successful summative evaluation eventually. For example, when appropriate stakeholders are not engaged in the evaluation, the final material may fail to be accepted eventually. The main factor for planning is the intention of the prototypes and the stakeholders to be involved, which then determine the appropriate techniques to be used (Soo & Liew 2007). There are many well-documented techniques in the literature, such as those described by Jonnassen, Tessmer and Hannum (1999).

While the prototyping developmental model has helped this project to get through Phase 1 successfully, it is not without its dangers. The developments can get out of hand, and diverse or frequent conflicting views may hinder the progress of the project. Boyle (2006) quoted maintaining time discipline and clear specification of outputs to mitigate failure of on-time delivery. The importance of good project management cannot be under emphasized in a project such as this. In addition, as can be seen in Figure3, this project also targets the stakeholders selectively, according to the intentions of the evolving prototypes.

Conclusion

E-learning has gained immense popularity in recent times. Debunking traditional notions of how teaching and learning have been taking place in educational ecology, e-learning has bridged the constraints of time and geographical distance that characterized the traditional learning system, and it has diffused into a flexible yet dynamic mode of study for populations of learners, taking into account their varied learning styles and needs. E-learning is now widely hailed and synonymously associated with a more effective and efficient learning outcomes (Onasanya & Ogunojemite, 2005).

Of the three phases in this project, the first is the most challenging although smallest in scale. However, the use of the prototyping development model has helped to successfully establish the team dynamics and clarify the instructional design principles with the key stakeholders of this phase. This small success is important as it sets the stage for the subsequent phases. This paper outlines the outcomes of the early analysis of the project and how these then influence the directions of the future project, including the decision for adopting a prototyping development model. Guided by this developmental approach, the paper then provides some insights into how the key principles of instructional design and evaluation come together to drive the design of the prototypes. In this way, the paper serves to illustrate a way of bridging the theory and practice of courseware development, and underscores the importance of principles in guiding course lecturers and other stakeholders .

The project is currently in Phase 2, and the target is to develop and transform the 15-week of self-instructional learning material into web-enabled prototype by the end of Phase 3. The material will then be used to engage the next set of stakeholders, course lecturers, IT officers, web designers and the students. The intentions are to gauge the effectiveness of the material on the target learners and to test the deployment strategies.

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