

Training for Real: Starting in the University

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Graduates of Engineering in Uganda face great challenges in the work place as they are expected to be fully prepared to start work with little or no further training. In view of this, training has to begin at the University, where it has been found that the quality of teaching is poor, by admission of the lecturers themselves. This paper reports on an initiative by Uganda Martyrs University to systematically analyse the nature of teaching in the Faculty of Building Design, and to design, develop, implement and evaluate an intervention in the form of training to equip lecturers with basic teaching skills. It is hoped that this will in turn increase the chances of students being trained for real.

Introduction

Training for real in the applied science professions should ideally start at school, especially at University level where students undertake specialized study. In the era of lifelong learning, it is becoming even more important to equip students with the most basic fundamentals of their disciplines upon which they can continue to build throughout their professional lives. Besides this, in view of the fact that scientific knowledge is growing at a very fast rate, it is desirable to equip students with the ability to learn, rather than giving them the knowledge itself since its validity may not last for much longer.

An inter-university workshop was held at the Uganda Martyrs University in October 2004 to find out what could be said about the quality of University teaching in Uganda. The report on this is not yet published, but the general consensus of delegates was that the quality of teaching left a lot to be desired and that steps had to be taken soon to remedy the situation. A possible cause for the low quality of teaching may lie in the fact University lecturers do not receive any formal instruction in teaching methodology. Some faculties offer periodic pedagogical workshops to their staff but attendance for this is still low. In the absence of such instruction, university teaching and learning has the following characteristics:

- Lecturers re-use material from their own University days
- The 'lecture' is the predominant delivery method
- Assessment is carried out in an ad hoc manner
- Student's main learning strategy is memorization

As a result of this situation is graduates that are insufficiently prepared for the world of work, and who lack the skills and motivation to carry out after-school learning.

An Initiative at Uganda Martyrs University (UMU)

Uganda Martyrs University is a small private University that has been in operation for ten years. At the Faculty of Building Technology and Architecture (BTA), it was decided to investigate the teaching and learning experiences of the lecturers and the students with respect to the intended learning outcomes in the curriculum in order to plan an appropriate intervention if a gap was found to exist.

It was further hoped that the results of the investigation could find wider application in other faculties at UMU or at other Universities in Uganda with some adjustment for local conditions.

The Perceived Problem

Before the investigation begun, the problem was perceived as having the following elements:

- There was low interaction with subject matter by lecturers as they prepared lessons
- There was low interaction with subject matter by students during lessons
- No attention was paid to the design of conducive learning environments.

The Desired Situation

At the outset of the investigation, it was desired that a way be found to increase the interaction by both lecturers and students with the content of instruction. Lecturers should move beyond the practice of merely summarizing material from various sources to present to students, and instead create a classroom atmosphere conducive to deep and meaningful learning. This would then support and carry the content being presented; in other words, design should extend to the learning process as well.

Limiting Factors

As expected, in any real situation, it is impossible to achieve laboratory conditions. The investigation faced the following limitations:

- The investigation was to be confined to the faculty of BTA (5 full time teaching staff, 29 full time students)
- A time limit of 3-6 months existed
- Intervention was to be ready for immediate implementation
- The investigator was only partly trained for the task
- Investigation was to be carried out at a remote location

In view of these conditions, a suitable methodology had to be found that would accommodate these limiting factors while minimizing the risks to validity of the investigation.

Theoretical Framework

The Nature of Higher Learning

Higher learning involves much more than just knowing of the world, the student should get to know about the world: how it works, how things are related, etc., and eventually be able to use this knowledge to solve problems not previously encountered. In order to learn this, students need to use more than just their six senses. The lecturer has to use analogies, diagrams, equations, symbols and other appropriate representations to widen their understanding of the world. There is a need to introduce them to new terminology, train them in the use evidence and argument to draw conclusions, to relate evidence to appropriate phenomenon. To achieve this leap, the following activities need to be carried out:

- Emphasis of the overall structure of the knowledge base to enable relevant connections
- Extraction of principles and concepts from everyday life so as to aid the students' buildup of knowledge about the world
- Use of clear representations and ensuring that they convey the meaning they are supposed to
- Providing feedback on the growing understanding about the world displayed by students
- Allowing reflection on knowledge gained, and emphasizing possible application in the real world

Principles of Instructional Design for Training

Systematic Design

A systematic approach to curricula design enables one to break down a complex problem into smaller manageable pieces. When it has been established that a problem does indeed exist (i.e. there is a gap between 'what is' and 'what should be'), the cause must be established so that a solution to respond to this cause can be pursued. Instruction/training is considered as an appropriate intervention when it can be shown that the cause of the problem is a lack of performance (as opposed to lack of resources, poor management, or the University curriculum for instance), and that the solution to the lack of performance is learning (as opposed to improved

conditions, better motivation, etc)

When it is clear that training is an appropriate intervention, design and development can proceed systematically thus:

- A break down of tasks that the lecturers carry out (or should be carrying out) in their day-to-day work, so as to determine training content.
- An analysis of characteristics of the lecturers that will undertake the training to determine instructional approach
- A thorough context analysis to determine who will administer the training and the available facilities.

When this has been completed, design criteria are set up, followed by development of the training curriculum, and finally testing and evaluation done.

Paradigms of instructional design

Vischer-Voerman, et al (2000) suggest that any one of four approaches to design can be taken, depending on the circumstances under which it is being carried out, and on the results sought.

Instrumental Design: strongly characterized by a systematic and logical sequence of events, it relies heavily on the early determination of all the goals to be fulfilled by the instruction. All actions thereafter (design, development, and evaluation) are assessed upon the extent to which these goals are being fulfilled. In short, in this approach, the end is specified from the beginning.

Communicative Design: the rationale behind this approach is that the people designing the instruction are often different from those who will benefit from it and so constant communication must be kept up with the end users throughout the design process. Consensus has to be reached by all stakeholders on the goals and form of the instruction at all times so as to increase legitimacy of the final product.

Pragmatic Design: the main focus here is to develop a product that is effective and useful. It involves an initial general analysis of the problem, followed by an early version of the eventual product (a prototype) to be discussed or tested by users on its usefulness. Suggestions for change are then integrated in a more improved version, which is also tested and improved if necessary. These cycles of change are carried out for as long as necessary until a suitable product is achieved.

Pragmatic design is suitable in cases where a solution is required in a short time, functionality of the product is highly desired and where the designer is a novice.

Artistic Design: In this approach, the designer has more control over how the problem may be defined, how to solve it and how to implement the solution. It calls for a high degree of competence and is usually a highly circuitous and convoluted process (Vischer-Voerman, et al, 2000).

Learning Theories for Real Training

Constructive Learning

Constructivist approaches to learning are quickly gaining prominence in educational technology and the philosophy

behind them is that reality is constructed, rather than discovered or transmitted (Smith & Ragan 1999). As a result of the different life and educational experiences individuals bring to a classroom, no two students will experience the same learning. To this end, a learning environment needs to be built that allows each individual present to construct knowledge by building upon their past experience or prior knowledge.

Deep vs Surface Learning

Students intent on merely obtaining a passing grade will often employ surface learning techniques to get through a class. These include studying what kind of answers a certain teacher looks for, focusing on key words or isolated facts, and putting in a minimum of effort while appearing to meet requirements. Lecturers themselves propagate this kind of learning by teaching in piecemeal fashion, and failing to hold students accountable for their own learning. Students using this kind of approach often feel anxious, unmotivated and overwhelmed by course requirements.

On the other hand, students for whom it is important to really understand something and apply it correctly, employ deep approaches to learning. These students strive to get the fundamentals, and to build rich mental networks of knowledge. Students using this approach report feelings of pleasure, interest and challenge. Lecturers facilitate this kind of learning by starting at an instructional level appropriate for the prior knowledge of students, by emphasizing structure of the knowledge base as well as real life applications, holding students to account over their learning, and assessing for structure rather than for isolated facts.

The two approaches have been found to exist in both Science and Arts subjects and there is evidence to show that lecturers' teaching methods can greatly influence the choice students make between the two.

Methodology

Taking into consideration the desired outputs of the investigation as well as the limiting factors, the following methodology was followed:

1. The investigation was supervised by a specialist in training design as part of a Master Thesis undertaken by one of the staff members at UMU (Educational and Training Systems Design at the University of Twente in The Netherlands).
2. The primary design paradigm adopted was the Pragmatic design process, supplemented by elements of systematic, communicative and artistic design
3. Both Primary and Secondary sources of Data were consulted to buildup the problem parameters
4. A systematic five-step approach to breaking down the problem and develop a solution was taken

Data Sources

Primary data

This data was so-called because it was collected specifically

for this investigation. It included:

1. On-line Questionnaires were sent out to three full time lecturers to collect opinions of the nature of the problem as they perceived it. In addition, some elements of these questionnaires determined motivation factors that could be used in eventual training.
2. The opinion of the faculty dean on the existence and nature of the problem with teaching was sought
3. Telephone interviews were held with lecturers to assess the effectiveness and usefulness of each prototype of instruction developed during the pragmatic design.

Secondary Data

This was data generated from indirect sources such as the feedback forms filled out by all students in the faculty bi-annually to assess lecturers and courses. The forms were examined to get a students' perspective on the perceived problem although responses from only one semester were readily available. Since this data had originally been collected for a different purpose, a coding system had to be developed to transform this information into a form useful for the investigation at hand.

The five-step process

From start to end, the investigation of and solution to the problem were conducted systematically in five major steps. From the definition of a system, an input, an output and a process occurring within the system have to be identified. Each step could therefore be shown to comprise a system thus:

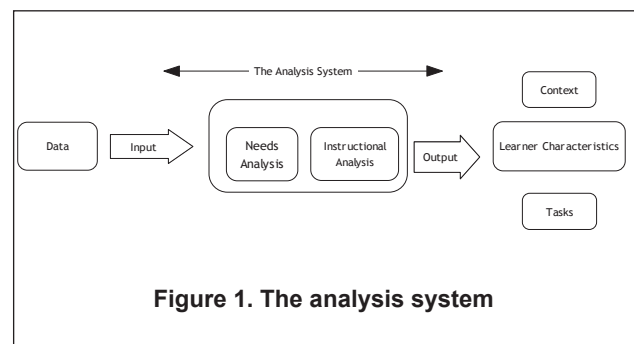


Figure 1. The analysis system

Primary and Secondary Data were the input for the analysis system. This data underwent a needs analysis to determine whether or not a problem really existed, and if so, if the solution to it is training. When this had been established, an instructional analysis was carried out to determine the ideal circumstances under which this instruction can take place considering the character of the learner, the context within which the problem was being tackled and the tasks to be learned.

The output of the problem analysis system included the learner, context and task characteristics.

Since the learner and context characteristics had implications for design, they formed the input for the design sys-

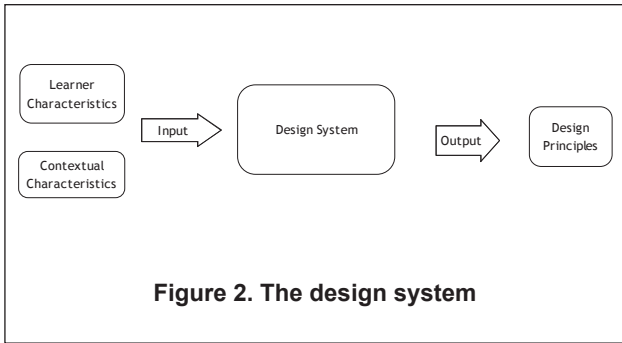


Figure 2. The design system

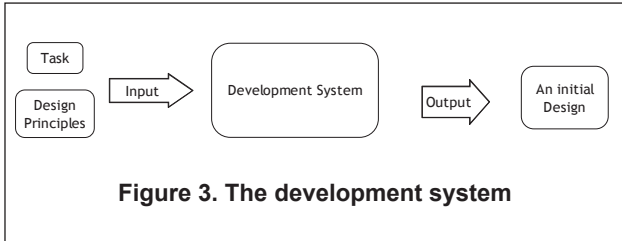


Figure 3. The development system

tem. In keeping with the chosen educational philosophy of constructivist learning, design principles were determined and formed the out put of the Design system.

The design principles were applied to the learning tasks to develop an initial design or prototype. This was to be tested by the future users for functionality and effectiveness so as to identify areas of improvement. During the development phase, the tasks were analysed further to determine the content to be included in the instruction as well as the strategies to employ in the organisation and delivery of the training.

The Implementation System

The Implementation phase of this project had two special characteristics:

Cycles of Change: owing to the fact that a pragmatic approach to design was employed, the implementation had to take place in phases. Each prototype tested provided feedback on the functionality that could be used to improve that prototype, and at the same time also provided input for the design of proceeding units. In this way, it was possible to adjust learning goals, delivery strategies, etc. for later prototypes and improve the feasibility of training overall.

Practicing as one preaches: The entire training advocated for constructivist approaches to University Teaching. To reinforce this, and to provide a model for the lecturers receiving the training, constructivist approaches were used in the organisation and delivery of the training itself. All design principles in the design stage grew out of and adhered to constructivist learning theory and practice. In this way, lecturers could experience first hand what kind of learning experience accompanied instruction grounded in constructivist theory and so better appreciate its character.

Evaluation is an inherent feature of the pragmatic design approach and as can be seen in fig 4 received input and also provided output for the Design, Development and Implementation systems. Two kinds of Evaluation were carried out:

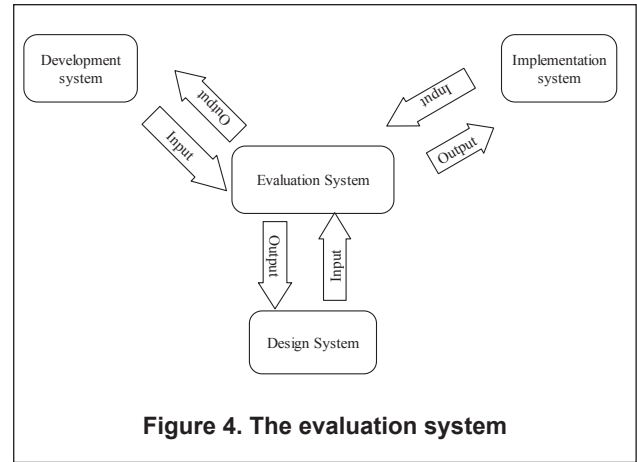


Figure 4. The evaluation system

Formative Evaluation is a kind of evaluation carried out with the view to improving a product. In this case, the following were the evaluation questions:

1. To what extent are the stated goals of the instruction being attained by the learners?
2. Does the instruction work well toward supporting the learning process?
3. Is there evidence that transfer of the training is occurring, or will occur to the job situation?

How effective are the changes arising out of feedback on the various prototypes in improving the instruction?

Summative Evaluation is carried out to provide a final judgement of the product as a whole. Experts in the field of University education provided answers to these questions:

1. Are the learning goals pursued in this instruction relevant for the job that lecturers have to carry out?
2. Are the approaches, suggestions, and methods suggested in the instruction feasible in the Ugandan University context?
3. In what ways could the instruction improve lecturers' skills in carrying out their teaching duties?

The methods used in the evaluation are summarised in Table 1 below:

Table 1. Methods of Analysis, interpretation and communication of data from formative and summative evaluation

Data Collection Method	Analysis	Interpretation	Communication
Semi-structured Interviews	Identify broad themes as related to goals of evaluation	Qualitative judgment of the value of the instruction considering goals of the evaluation	(i) Verbally describe judgment reached
Semi-structured Questionnaires			(ii) Where changes in design are called for, summarize as action statements
Informal Activities			

The evaluation was carried out using semi-structured telephone and written interviews with the users testing the training, as well as lecturers considered to be expert at the job.

Since the investigator's design skills also improved with each passing each prototype, she was able to carry out evaluation through informal discussions with colleagues and supervisors, and by literature searches and general reflection on the content of the instruction.

Results

Problem Analysis

Data used to analyse the problem was collected from students, lecturers (including the investigator) and the faculty dean. The following emerged as recurring issues needing attention:

Table 2. A summary of problematic issues raised by Dean, Lecturers and Students

	Issues	Who Agrees?		
		Dean	Lecturers	Students
1	Course Design	✓	✓	✓
2	Delivery Strategy	✓	✓	✓
3	Assignments / Projects	✓	✓	✓
4	Relevance of course material	✓	-	✓
5	Class Management	-	✓	✓
6	Student Mentoring	✓	-	-
7	Administrative	✓	-	✓

Following this analysis, the problem could be stated more precisely before design of training could proceed:

Problem Statement

Lecturers currently deliver the content in their courses, without sufficient regard to the design of the learning process that should attend it. This has been discovered to be due to a lack of didactic skills and has resulted in low interaction with subject matter by both the lecturers and the students.

Design and Development

Learning Goals

In response to the issues raised in the problem analysis, the following were selected as appropriate learning goals:

1. Provide practice with the analysis of initial learner and task characteristics
2. Provide practice with development of learning goals
3. Assist Lecturers to develop a vision for their Teaching and Learning
4. Provide practice with the development of Teaching Strategies
5. Provide instruction and practice in the design of course and lesson outline
6. Provide practice with choosing evaluation methods.

Design Principles

By taking context, learner and task characteristics into consideration, and applying constructive principles to the three, the following **TEN** principles emerged to guide the investigator in design:

Goals: The goals of the instruction were to be clearly stated and would incorporate lecturer needs and interests as far as possible

Tasks: These would resemble real life conditions in order to facilitate construction of knowledge onto the existing knowledge structures of lecturers

Structure: The inherent structure of knowledge was to be emphasized in both the content layout and the presentation so as to facilitate construction in easily accessible mental formats

Transfer: the possibilities were to be clearly highlighted within the tasks and content so as to increase the chances of the application of the new knowledge in the work context

Assessment: This would be integrated in the learning tasks as far as is possible to increase the possibility of mastery of tasks over memorization of content

Communication: Mechanisms of regular and meaningful communication between lecturers and training facilitator would be set up to provide needed support

Feedback: Lecturers were to be provided with regular and timely feedback to facilitate learning and retention

Content: This would be confined to basics of course design in keeping with the low prior knowledge of lecturers and in fulfillment of their stated needs

Motivation: Novelty and variety would be employed in the tasks, illustrations and assessment to increase motivation. In addition, the tasks would be made challenging enough to engage and hold the lecturers' interest.

Flexibility: Lecturers would have a choice in how to follow the instruction to achieve the different goals at their pace.

Delivery Strategies

The context analysis revealed that lecturers couldn't meet as a single group to take the instruction, nor could they follow it all at a go so enable them to follow the instruction at their own pace, it was decided to offer the instruction online. An open source learning environment known as **Moodle** was chosen.

Using Moodle, each student was assigned password protected access to the learning material and received personalized feedback. S/he was also able to post comments and queries to the facilitator or to fellow lecturers, thus enhancing a sense of community while preserving individuality. In addition, Moodle is particularly suitable for systematic and structured presentation of instructional content. In this way, it supported at least three design principles: Feedback, Communication and Structure.

The Instruction

The Instruction was divided into three units. Lecturers were provided with a general framework within which course design occurs and this was used as a basis for structuring the entire instruction.

At the end of the instruction, lecturers were led through a reflection exercise to ensure that the all knowledge acquired through the instruction was mentally coded in terms of the framework of course design encountered at the beginning.

Box 1: A General Framework of Course Design

A systematic model of course design will involve the following steps.

- **Unit One:** Analysis
 - Learner
 - Context
 - Subject/Task
 - Types of Knowledge
 - Determining learning goals
- **Unit Two:** Choosing Instructional Strategies
 - Delivery
 - Media
 - Grouping
 - Material
 - Organisational
 - Teacher centred Vs. Student Centred
 - Learning Activities
 - Management
 - Load of reading, assignments, etc.
 - Scheduling
- **Unit Three Part A:** Evaluation
 - When to, why to, how to
 - Formal and informal evaluation
- **Unit Three Part B:** Lesson/Course design
 - Writing the course outline

Implementation: Cycles of change

Although the general framework and overall goals of the instruction were developed at the start, the detailed design was carried out unit by unit, with each unit being administered and evaluated before the next could be fully developed. This was to allow for the evaluation results from each unit to be incorporated in the next prototype, as well as be used to improve the foregoing prototype.

Box 1 shows a general framework for course design.

Fig 5 overleaf shows a final framework for course design.

Key features of instruction

Unit Overview

Each unit begun with an overview of the goals to be pursued in that unit, as well as a summary of its content.

Pre-Unit Assignment

This feature developed as a result of the formative evaluation of Unit One. Its purpose was to test the prior knowledge of lecturers in the content of the unit in question, as well as give them an early indication of what to expect. Testing the prior knowledge also made it easier to measure the attainment at the end of the instruction

Instruction-example-assessment

The content in each unit was divided into sub-parts that presented the instruction, followed by a real life example, and finally an exercise/assessment that had to be applied by lecturers to their own real life University courses to make it more practical.

Offline resources

It was found that the lecturers had only limited access to the internet so extra reading was provided as offline resources to be printed and studied at leisure to widen their understanding, and also help them to prepare their assignments.

Evaluation

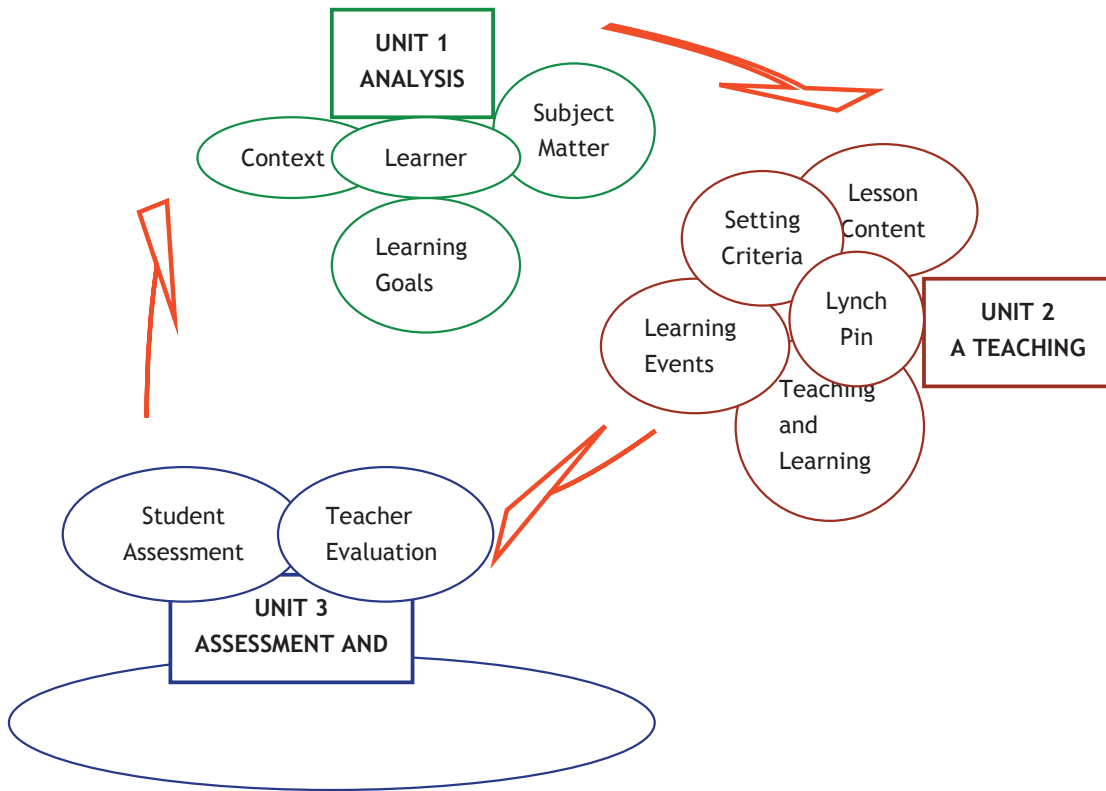
Formative evaluation

The results of the formative evaluation were reduced to action statements and used to improve each unit. These however were too detailed to include in this paper.

Summative evaluation

The experts found the instruction relevant for the following reasons:

- it would help lecturers determine the most effective approaches to teaching
- It would enable lecturers to define learning goals more accurately
- lecturers would (and needed to) develop a specific vision for teaching and learning
- lecturers would be made aware of the need to, and the process of motivating their students
- their would be increased of the necessity to carefully



Unit One : Analysis			
<u>Context</u>	<u>Learner</u>	<u>Subject Matter</u>	<u>Learning Goals</u>
Characteristics	Characteristics	- Blocks - Themes	- Level I and Level II goals

Unit Two : A Teaching Strategy				
<u>Teaching and Learning</u>	<u>Setting Criteria</u>	<u>Lesson Content</u>	<u>Learning Events</u>	<u>Lynch Pin</u>
- Levels of Teaching - Deep and surface learning	- Student Motivation - Learning Styles - Elements of an Effective Learning Environment	- Types of Knowledge (Skills Cognitions Affects)	- S-R Events - Three Phase Lesson Plan - Common Delivery Methods	Putting it together in your own way

Unit Three : Assessment and Evaluation			
<u>Teacher Evaluation</u>	<u>Student Assessment</u>	<u>Course Outline</u>	<u>Summary</u>
- Self Evaluation - Redesigning a course	- Four Questions to answer in Assessment - Assessment Techniques - Grading & Feedback	- Why - How	- A frame work of Course Design - Course Evaluation Questionnaire

Figure 5. A final framework of course design

plan evaluation to fulfil learning goals

- Students were likely to learn better, and develop their potential more fully if lecturers followed the instruction.

Conclusion

The purpose of this paper was to report upon an initiative by one University to improve the learning attainment of their students by improving the teaching skills of the lecturers. The process of designing this training started with a general analysis of the problem, followed by building and testing a first prototype. Two more prototypes were built using the feedback from users and formative evaluation until a final product was produced. Further, an expert appraisal showed that the training would be useful in fulfilling the goals it set out to fulfil.

In Uganda, when students join the workforce, they are expected to have learnt enough to get to work immediately, and continue to work with little or no further training. Given this atmosphere, it is the responsibility of the university (or other institution of higher education) to prepare students as fully as possible for their future. In addition to this, they should be equipped both with an awareness of the necessity of, and the skills to carry out, future self-mediated learning.

Alongside the constructivist movement in education is the belief that since knowledge changes so quickly in the emerging knowledge society, it is desirable to turn out graduates who possess the ability to learn and adapt to new knowledge and technology as opposed to those armed with facts and figures. This of course does not remove the necessity of equipping students with knowledge of basic concepts and principles in a given discipline as these tend to stay the same.

The challenge then is to strike the right balance between the two and this is the purpose of emerging educational trends such as explorative learning, student centered teaching, peer to peer learning and instruction, and reflective learning.

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