

# Online Self-Tests : A Powerful Tool for Self-Study

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**Abstract:** *'Any Where, Any Time' access to formative feedback about Self-Study allows the distance learner to concentrate his Self-Study precisely on those content areas where his understanding is weak. Immediate recognition of Self-Study achievements of a distance learner in comparison with other fellow students is a strong motivation for further Self-Study. The 'Online Self-Test' is a simple and effective solution for dealing with two common concerns of almost all distance learners viz. lack of time and lack of motivation.*

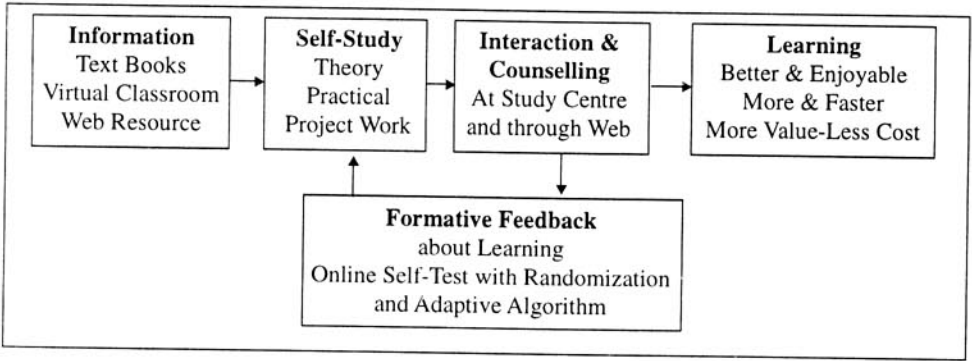
*This paper aims to examine a few vital design issues pertaining to 'Online Self-Test'. It also presents real experiences gained during the implementation of the 'Online Self-Test Centre' for Yashwantrao Chavan Maharashtra Open University, Nashik, India, and demonstrates how Internet, with its present technology limitations and costs, can be effectively used to improve the Self-Studies of distance learners.*

## Introduction

Recently, India has witnessed an explosive growth of 'Internet'. It is estimated that before the year 2004 begins, about 23 million users will be using Internet every day. Strong support for the use of Internet in education is clearly evident in the funding pattern from Central as well as State governments. Easy, fast and reliable access to Internet, from almost all parts of India, is almost a reality even today. The growth of 'Internet' in India, is a classic example of how quickly new technology is being absorbed by this country.

Internet, with its present technology limitations and costs, can be effectively used to deliver world-class educational services with better quality, accessibility and flexibility. ELearning means learning with the help of Internet and is considered as the fourth generation model for distance education. With ELearning, an open university can convert the present "Teacher-Centred" educational system into a highly responsive and dynamic "Learner-Centred" personalized educational system. "Quality education, Anywhere, Anytime" is not far from today. "ELearning" is a giant step forward towards "Quality education for all, with cost effectiveness, at the doorsteps of learners". ELearning can be graphically shown as given in Fig.1.

Knowledge is expanding at lightening speed. Learners need to learn more, better and faster. Open universities must use innovative distance learning tools for better and effective self-study by distance learners. But, before we present these tools, it may be



**Figure 1 : E Learning**

appropriate to provide background information about the university and the academic programme, where these tools were used.

Since 1992, Yahwantrao Chavan Maharashtra Open University has been offering Electronics Engineering Diploma programmes (EED). These were the first technical programmes offered through distance mode in India. Naturally, it was quite hard for the people to place faith in the academic quality of EED, and thus till 1996, student enrolment for the programmes was hovering at 100-200 students every year.

An 'experiment kit' was developed with a view to allowing the learner to perform many different electronics experiments at his convenient place and time. Programme implementation effectiveness was substantially improved with the introduction of various managerial innovations. Over a period of time, the curriculum was totally revamped to ensure relevance to today's industry and student needs. These changes initiated explosive growth in student enrolment from just about 150 students in 1996, to about 3500 students in 2001. These changes also improved the drop-out rate from an initial 40% to the present 25%.

All over the state of Maharashtra, about 168 counsellors at 42 different study centres offer academic support to these students, distributed over 0.3 million km<sup>2</sup> of territory (about 800 km north-south and 600 km east-west). This is the first technical academic programme in India, offered with web-based ELearning methodology. With this kind of web-based support, it is believed that this programme will set the standards of academic excellence, with effective programme implementation systems.

Most open universities in India, use a few (normally 1 or 2) Class-Tests and Home-Assignments for each course as a tool for continuous evaluation of the Self-Study. This system has the following serious limitations:

- The student has to visit his study centre, on a scheduled date and time, for Class-Tests. Normally, this also involves considerable travel time and expense, which may not be feasible for many students.
- Academically it is highly desirable to arrange frequent Class-Tests and Home-Assignments. But due to administrative and financial reasons, these cannot be arranged for more than 1 or 2 times in a term.

- The present system is heavily dependent on poor and slow communication infrastructure like regular postal system and large number of counsellors at various study centres. Hence, it is difficult to maintain good and consistent quality all the time, across the study centres. Due to this fact, coupled with presence of a large number of learners, it is very difficult to provide proper and timely feedback about Self-Study to each learner and thus motivate him for further Self-Study.

Due to these limitations, Open Universities are forced to assign low importance to the continuous evaluation component, which in turn, results in poor interest of learners in their studies.

### **Overview of Online Self-Test Centre**

The following design objectives were set before the development of the “Online Self-Test Centre”

- Any time, anywhere quick Self-Tests, for as many times as the learner wants;
- Better motivation with proper and timely feedback about Self-Study;
- Better evaluation quality, flexibility and efficiency;
- Better tolerance to Internet disconnection;
- Shorter training and learning time to take “Online Self-Test”;
- Better knowledge, experience and skills for learners;
- Reduced travel time and costs for learners.

Although better choice of software and hardware may be possible, considering the already available software expertise, software and hardware resources and other environmental factors, the following standardization of software and hardware is presumed to reduce

- development time and cost for the university, and
- familiarization and learning time for the users.

Server Side: The University web site will be hosted by the web server (located in India to eliminate problems due to congestion of its international link) with following or better specifications:

- Windows 2000 or better server operating system
- MS SQL 7.0 or better as a back end for Data-Services
- ASP 3.0 support for dynamic web contents
- Front Page 2000 support for static web contents
- Windows Media Service for audio visual multimedia web cast.

Client Side: All students and study centres will use minimum Celeron or PII or PIII MMX ready processors based PC with

- Minimum 233 MHz or better speed
- Minimum 32 Mb or better RAM
- MS Windows 98 or better operating system
- Minimum 28.8 kbps or better speed for Internet access
- 800 x 600 resolution at 16-bit colour and small font setting
- MS Internet Explorer 5 or better for browsing
- MS Outlook Express 5 or better for POP3 emails communication
- MS Media Player 7 or better for browsing multimedia contents.

The “Online Self-Test Centre (OSTC)” is a dynamic web application. A university is supposed to feed sufficient number of Multiple Choice Questions (MCQs), in a Question Bank (QB), before it can announce the availability of Self-Tests for any single course. After Self-Tests are available, learners can choose to appear for a challenging online Self-Test on selected unit(s) or on the complete course.

Each MCQ is randomly selected from the QB on the fly, only after submission of the previous question. Options for each question are also randomly placed. An adaptive algorithm dynamically adjusts the difficulty level of the subsequent question based on the response given to the previous question.

The current question number and maximum number of questions in a Self-Test are clearly displayed with every question. Each question is displayed for a period of its *current* ‘Response Time’. Only during this time duration, the learner is allowed to submit an answer. The remaining time for ‘submission of an answer’ is continuously displayed at the lower left side on status bar. After submission of an answer to the question, the learner is *not allowed* to go back and correct any wrong answer submitted earlier. Learners are alerted if the remaining time falls below 30 seconds.

If the Self-Test is on a complete course, then MCQs are randomly selected from the QB as per the evaluation blueprint of the course. Questions item status is dynamically updated after its submission by the learner. The maximum number of questions in a Self-Test is decided by the credit point assigned to a course.

Immediately after submission of the last question

- The result is displayed indicating the ‘Total Weighted Score (TWS)’ with total number of right and wrong responses, number of questions attempted and total questions, etc. If the Self-Test is on a complete course, the learner’s ‘Percentage Rank’ among all previous test takers is also indicated. Prompt personalized result declaration strongly motivates the learner for further Self-Study.
- Valuable feedback about Self-Study is provided in the form of all MCQs which receive wrong responses. Hence, the learner knows precisely where his Self-Study is weak and where he needs to improve.

## Features of Online Self-Test Centre

### Random Selection

1. Each MCQ is randomly selected from the QB on the fly, *only after submission of the previous question.*
2. If the Self-Test is on a complete course, then this random selection is as per the evaluation blueprint of the course.
3. Randomization is done in the sequencing of questions in a Self-Test.
4. Options are also randomly placed for each display of each question.

**Adaptive Algorithm:** This feature dynamically adjusts the difficulty level of the next question that will be displayed based on the response to the previous question. Initially, it starts with “Average” difficulty level. After that, if the response to the previous question was

- *Right*, then the next question will be *more difficult*, if available in QB
- *Wrong*, then the next question will be *less difficult*, if available in QB.

*Thus, it is extremely difficult to achieve very high or very low scores as learner will face far more number of difficult or easy questions respectively.*

**Total Marks:** Self-Test’s total marks are total of individual marks of all randomly selected MCQs as per the adaptive algorithm. As each MCQ’s individual mark may be different from other, each Self-Test’s total marks may be different.

**Dynamic Update:** The difficulty level (Facility value) and response time parameters of every item are dynamically updated after it is *used 10 times in different Self-Tests*. Its status in this regard is updated as follows:

*Difficulty level* is dynamically updated to reflect the current response history for the item. Thus if an item receives ‘right’ responses for

- a. more than 80% of its previous usage, then its difficulty level is considered as “Very Easy”
- b. only 60-80% of its previous usage, then its difficulty level is considered as “Easy”
- c. only 40-60% of its previous usage, then its difficulty level is considered as “Average”
- d. only 20-40% of its previous usage, then its difficulty level is considered as “Difficult”
- e. less than 20% of its previous usage, then its difficulty level is considered as “Very Difficult”

**Response time** is dynamically but gradually updated to reflect the current response history for that item. But, if the learner requires less than 10 seconds to respond, then ‘Response Time’ history of an item is not updated. If the average time of response during its previous usage is

- More than 75% of its “Current Response Time (CRT)” then CRT is increased by 10%.
- Less than 75% of its CRT then CRT is reduced by 10% up to minimum 40 seconds.

*Total Time Duration:* A Self-Test’s total time duration is a total of individual time duration of all randomly selected MCQs as per the adaptive algorithm. As each MCQ’s individual time duration is dynamically updated, each Self-Test’s total time duration may be different. This time duration is precisely controlled by the computer. It is also continuously informed to the learner during the Self-Test.

*No Access to Correct Answers:* Correct answers to any MCQs used in the ‘Self-Tests’, are *never indicated* by the “Online Self-Test Centre”. Important benefits of this policy are as follows:

- Promotes exploratory type of Self-Study, which is the most enjoyable form of learning
- Resists memory based Self-Study
- Longer life of a “Question Bank” because of increased re-usability of individual items.

*Total Number of Items:* The ‘total number of MCQs’ in a Self-Test change as per the type. A Self-Test is of following 2 types:

- Self-Test on a complete course
- Self-Test on a selected unit or combination of 2 or more units.

The Self-Test on a *complete course* can have maximum total

- 20 MCQs for 4 credit point course (subject)
- 30 MCQs for 6 credit point course (subject)
- 40 MCQs for 8 credit point course (subject)

If a Self-Test is on a single unit or combination of few units, then it will contain *minimum 5 MCQs on each unit* provided that ‘maximum total number of MCQs for a Self-Test on a complete course’ is not exceeded, otherwise it will distribute this maximum total number of MCQs, *approximately equally* among all the selected units.

*Report and Feedback:* Report and feedback are completely personalized with the name of the learner, date and time of Self-Test, etc. It is designed for better motivation and clarity. The following parameters are included in this part:

1. “Total Weighted Score (TWS)”, with brief score interpretation
2. “Percentage Rank”, *only if Self-Test was on a complete course*
3. “Average Time” taken by the learner to respond
4. Total number of Questions in the Self-Test
5. Total number of attempted Questions in the Self-Test

6. Total number of right answers
7. Total number of wrong answers
8. "Feedback" which include *all* MCQs in the Self-Test, which receive wrong answers from the learner. This feedback *does to include* right answers. Learners are expected to focus their 'Self-Study' for exploration of answers to these questions.

### **Benefits of Online Self-Test Centre**

*Better Evaluation Quality:* With all these state of art features, the evaluation quality can be really very good. During the few sample "Self-Tests", it was observed that *even open access to*

Standard Textbooks or

Reference Books or

Learner's notes taken during counselling sessions,

*can not improve performance* due to complete randomization, adaptive algorithm and fully computer controlled meticulous execution of Self-Test. With this, it is hoped that our present memory based evaluation system will come closer to real life situation, where access to knowledge resource is available when ever needed and still performance can not be improved without appropriate knowledge abilities like comprehension, application, analysis, etc.

*Reduced Training and Learning Time:* For using the "Online Self-Test Centre", the learner will just need to know how to browse the Internet using MS Internet Explorer 5 (IE5) or better. As interface of IE5 and "Online self-Test Centre" is highly intuitive, the learner will hardly need any special training. Exposure for just about 10-15 minutes will be enough for getting acquainted with the system. Online virtual Classroom Modules are also available for training learners for this skill.

*Better Motivation:* The result, including the learner's 'Total Weighted Score (TWS); is immediately displayed after submission of the last question in a Self-Test. Even his 'Percentage Rank' among all previous test takers is also immediately displayed for the 'Self-Test' on a complete course. In addition to this, the result display is *fully personalized* with the name of the learner. This feature strongly motivates learners for further Self-Study.

Adaptive algorithm also helps to boost motivation of

- Students with poor performance, as it provides more number of easy MCQs during the Self-Test and thus helps them to correctly answer more number of questions;
- Students with higher performance, as it provides more number of difficult MCQs during the Self-Test and thus offers them more academic challenge.

*Better Feedback:* Valuable feedback about Self-Study by the learner is immediately provided after submission of the last question in a Self-Test. This feedback includes all MCQs to which learner provided wrong responses. With these MCQs, the learner can

easily locate weak areas in his/her Self-Study and precisely concentrate his learning efforts around these topics. Hence, this feedback “really” helps to improve time efficiency of Self-Study.

*Better Security:* Due to complete randomization and Adaptive algorithm, for any person (including the system administrator of the server), it is impossible to have access to further remaining questions in the Self-Test. This is a great security feature, if instead of just providing feedback about Self-Study; some organisation intends to use this system for “real” evaluation under controlled conditions like examination centres with external supervisors.

*Better Knowledge:* Learners enjoy taking “Online Self-Tests”. It retains the privacy of learners. It provides precise feedback about Self-Study by learners. It also motivates learners for further Self-study. Learners can repeat Self-Tests several times. Naturally, learning is much more effective with this kind of respective exposure. Thus, it is believed that the “Online Self-Test Centre” will help learner to acquire much better knowledge, experience and skills.

*Better Immunity to Internet Disconnection:* Internet connection in India is now quite reliable. But due to external technical problems, sometimes the connection can get disrupted during the Self-Test. In such an event, within four hours, the learner can resume the *same* “Online Self-Test” starting exactly from the point of discontinuity. This feature gives much better immunity to Internet disconnection and learner’s efforts for Self-Test do not go waste.

*Any Where, Any Time Access:* Learners can use the “Online Self-Test Centre” at any time (all 24 hours of a day), from any computer (located any where in the world) having access to an Internet. This ‘any time any where’ access is available as many times as the learner wants, during all 365 days of a year. Simultaneous use by multiple users is also possible. Thus several learners can take Self-Tests during the same time slot, from any nearby cyber cafe, EEDP study centre or even from their homes, if they have their own personal computer with an Internet access. This also substantially reduces travel time and costs for the learners.

*Quick and Fast Response:* Almost all learners appear for a Self-Test from India. The “Online Self-Test Centre” is hosted on a fast server located in India. Possibility of slow response, due to congestion of an international link, is thus eliminated. Choice of the latest software tools also improves the speed of response. Hence, response time is fast and thus learners can quickly finish their ‘Self-Tests’.

*Complete Flexibility:* Learners can choose to appear for a Self-Test, consisting of only Multiple Choice Questions (MCQs), on a

- Complete course (subject) or
- Selected single unit (chapter) in a course (subject) or
- Combination of unit(s) in a Block (Book) of 1 credit point
- Combination of any selected units (chapters) in a course (subject).



## Key Issues for Development

*Attributes of Items:* The “Online Self-Test Centre” allows us to specify the following important attributes for each MCQ:

- Unit and Block of content
- Stem of question
- 4 options, out of which 1 must be correct and 3 should be distractors
- Optional Paragraph
- Optional *separate* image for stem and each of 4 (four) option
- Allotted Marks. But during computation of ‘Total Weighted Score’, marks are weighted as per the difficulty level.
- Time allowed for response (Dynamically Updated)
- Difficulty Level (Dynamically Updated) and
- Evaluation objectives like knowledge, comprehension, application, analysis, synthesis, judgement, etc.

*Question Bank Requirements:* For proper randomization, the “Question Bank” for a *complete course* should contain minimum 50 or more MCQs for each credit point. Hence, the “Questions Bank” for a *complete course* should contain

- Minimum 200 or more MCQs for a 4 credit point course (subject)
- Minimum 300 or more MCQs for a 6 credit point course (subject)
- Minimum 400 or more MCQs for an 8 credit points course (subject)

Normally, for proper randomization during the Self-Test on a unit or combination of units (chapters), the “Question bank” should also contain minimum 10 or more MCQs for *each unit* in a course (subject).

*Evaluation Blueprint:* Maximum total number of MCQs in a Self-Test is fixed by the credit points of the course. This maximum total number of MCQs is first divided among each block of units (chapters) having total 1 credit point. As per the importance of course contents in the block, this division may allocate different number of MCQs to each block. Although the evaluation blue print allows this uneven distribution, it is worthwhile considering having an equal distribution in the interest of simplicity.

Total number of MCQs allocated to each block is then further divided among each unit (chapter) in the block. As per the importance of course contents in the unit, this division may allocate different number of MCQs to each unit from other. Although the evaluation blue print allows this uneven distribution, it is highly recommended *not to distribute MCQs among the units*, and to allow ‘randomization with adaptive algorithm’ to take care of the distribution among the units.

It is important to note that the evaluation blueprint used as the basis for the “Online Self-Test” allows us to distribute the ‘number’ of MCQs among the block and then

among the units there in. But evaluation blueprint *does not allow* us to distribute the 'total marks' among the block and then among the units there in. As each MCQ used in Self-Test may have different marks, importance assigned to each block or unit in terms of 'marks in a Self-Test' is 'really' decided by 'randomization with adaptive algorithm'.

If we assign equal marks to all MCQs, during feeding them in the "Question Bank" of the course, then this problem is automatically sorted out. This normal but simple trick will always ensure distribution of 'number of MCQs as well as marks' among the block and then among the units there in. Hence, in this way, academicians can always assign importance to each block or units in terms of 'marks in a Self-Test' as per the evaluation blueprint.

*Total Weighted Score (TWS)*: Each MCQ is assigned the following weightages, in the computation of 'Total Weighted Score (TWS)' of a learner in the Self-Test:

1. For "Very Difficult" MCQ, the assigned weightage is 1.0
2. For "Difficult" MCQ, the assigned weightage is 0.9
3. For "Average" MCQ, assigned weightage is 0.8
4. For "Easy" MCQ, assigned weightage is 0.7
5. For "Very Easy" MCQ, assigned weightage is 0.6

As "Difficulty Level" is dynamically updated, the assigned weightage to each MCQ may change with time.

"Weighted marks of the MCQ" is computed by multiplying "Allocated Mark(s)" by "Assigned Weightage" of the MCQ. "Total Weighted Score (TWS)" is computed by dividing the "Sum of weighted marks" for all correctly answered MCQs" by the "sum of allocated marks for all MCQs" in the Self-Test.

If the Self-Test is on the complete course, *only then* "Percentage Rank" is computed. It indicates percentage of all of the previous learners, who have taken Self-Test on the same complete course, but achieved lower "Total Weighted Score".

*Maintenance of Quality of QB*: The item status is dynamically updated after its submission by the learner. All the following important parameters about each item usage are recorded. With this log and exhaustive report system, it will be easier to maintain QB or better evaluation quality:

- Number of times each option was selected by all previous users,
- Number of right and wrong selections by all previous users,
- Average Response Time taken by all previous users.

### **Key Issues for Implementation**

The Yashwantrao Chavan Maharashtra Open University (YCMOU) could deploy the English version of this "Online Self-Test Centre" in just about 6 weeks. Development of the Marathi version (Regional Language of the state of Maharashtra) has already

started and its completion is expected in the near future. *Clear and approved honorarium rate policy for “ELearning Material and Services Development” was instrumental for this fast and smooth development.*

Normally, all open universities in India will need the following 2 (two) versions to provide “Only Self-Test” services for all academic programmes on offer:

- English Version
- Regional Language Version

The development of “ELearning Material and Services” like the “Online Self-Test Centre” requires very little expense compared to its utility. It is also an easy task of development for any open university. Implementing the following steps may ensure smooth development and deployment:

- State clear honorarium rate policy for “ELearning Material and Services Development” and get it approved from the required statutory bodies.
- Develop the “Online Self-Test Centre” with the help of external Information Technology (IT) resource persons.
- Develop the question bank, consisting only of multiple choice questions, on those courses where there is large student enrolment, with the help of internal or external academic resource persons.
- Launch the “Online Self-Tests” for those courses, where question bank development is complete.
- Disseminate benefits of its use, among all students and study centres of the University.

### **Conclusion**

Internet will have an impact on every aspect of how students learn. The “Online Self-Test Centre” will certainly have much more profound impact on open and distance education system in India in the years to come. “Self-Study by Distance Learners” is a fundamental and most important postulate of an open and distance education system. When compared with the present scenario, Self-Study by distance learners will be significantly better with the “Online Self-Test Centre”. Hence, all open universities of India should rapidly plan and execute the introduction of “Online Self-Test Centre” and thus gear up to face the challenge of the new millennium.

(You may visit <http://www.ycmou.com/> for a live demonstration of these challenging “Online Self-Tests” assessment).

[**Note:** The author wishes to express special thanks to the following resource persons for their significant contribution in the conceptualization and development of an “Online Self-Test Centre” and also this research paper: Prof Ashok Pradhan, and Dr Anuradha Deshmukh, of YCMOU and Mr Kshemankar Bhore of Kshem Software.]

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