

DESIGNING AND VALIDATING AN E-LEARNING MODULE FOR AGRICULTURAL RESEARCHERS

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ABSTRACT

Market driven agriculture demands agricultural scientific community to have an understanding of all the facets of World Trade Organization (WTO) and their implications, for conducting need based and well-timed researches. Diverse teaching methods and tools are to be looked upon for effective delivery of the content on WTO issues; thus an attempt was made to study the compatibility and suitability of e-learning material in imparting knowledge of WTO. Therefore, an e-learning module on WTO with special reference to agriculture for agricultural researchers was designed, tested and validated.

The investigation revealed that issues of WTO, which seem like a macro-economic phenomena, can also made interesting by explaining concepts and ideas with relevant examples, visuals and well-structured story telling format. Usability evaluation score denotes a strong agreement among the respondents about effectiveness of the e-module with respect to aspects like content, supports, visual design, navigation, accessibility, interactivity, self-assessment, learnability and motivation to learn. The validation, using comparison of knowledge scores obtained before and after the exposure to the e-module, revealed that the e-module met its pre-defined objectives as well as learner's expectations.

Key words: E-learning, WTO, designing, validating, researchers.

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Introduction

Agricultural policies no more find its base in mere food demands and buffer stock availability. Changes in trade pattern, particularly in post-liberalization era, suggest that India has to formulate its future agricultural policies considering sentiments of the international market (Kumar & Singh, 2008; Samal & Behera, 2004; Ratna et. al., 2010; Varghese, 2011; Singh, 2011). World Trade Organization (WTO) deals with the global rules of trade between nations; therefore, for market driven agriculture knowledge of WTO is a prerequisite. WTO, especially Agreement on Agriculture, may seem like a macroeconomic phenomenon, but it has larger implications for all the stakeholders of Indian agriculture. Presently, study of issues of WTO have been predominantly dealt by social scientists; but to sustain and grow in current dynamic international market, Indian researchers need to analyze various dimensions of globalization across the disciplines. Scientific community in India must be aware about the basics of WTO, its rounds and their likely implications for taking up need based research. Contrarily, several studies have revealed that even researchers are poorly aware about various facets of WTO (Thanh, 2004; Vidyasagararya, 2003). WTO talks implicate many challenges to Indian agriculture; and to face those challenges posed by WTO, it is very much necessary to empower researchers with basic knowledge of WTO (Staff, 2004).

Researchers have reported that scientists come to know about WTO issues mainly from newspapers, magazines and journals; specifically through electronic media (Thanh, 2004; Siddiqui et. al., 2005). Evidently, traditional teaching methods have not been much effective in sensitizing and building specific knowledge about WTO among agricultural researchers. In this knowledge-based society, the future of learning needs to be holistic; and to become a lifelong activity, learning has to cut across temporal and spatial barriers. Therefore, researchers must be provided with learning materials utilizing new Information and Communication Technology (ICT). E-learning is costlier at establishment stage but cheaper at delivery compared to classroom teaching. Moreover, it reaches learners spread over wider geographical areas, within limited time and resources to travel, and busy with work commitments which may not allow them to attend courses on specific dates with a fixed schedule. Independence of learning and learner specific content based on their needs and interests can lead to effective and efficient building of cognitive skills. E-learning technologies such as e-portals, e-conferencing, e-

mentoring, online education, etc. have been proven to be quite effective in increasing the level of learning and are becoming an integral part of lifelong learning (Khalil, 2013; Sung et. al., 2014; Hussain, 2013; Chinyio et. al., 2006; Thompson et. al., 2010; Ionescu & Ionescu, 2011; Maiorescu & Rodica, 2013; Micu et. al., 2012; Varga et. al., 2013; Condruz & Monica, 2013; Canter, 2012). Many organizations are adopting e-learning technologies for capacity building of their human resources.

Developing e-learning materials involves identifying training needs, defining the universe of content, sequencing of topics, defining learning objectives and expected outcomes, formulation of instructional strategies to achieve those learning objectives, developing instructional materials to meet objectives; and finally, testing and validation of e-learning material. Self-instructional learning material must be able to motivate learners to learn, since motivation to learn is a major issue particularly for the adult learners. E-learning module must be able to enhance learning and add to the knowledge of learners. Testing and validation ensure acceptance of e-learning material by the target learners and its effectiveness in increasing knowledge and understanding about the subject matter at hand. In this context, the present study was formulated to design, test and validate e-learning module on WTO issues with special reference to agriculture for agricultural researchers.

Materials and Methods

The present study was conducted in a scientific, systematic and properly planned way (Kerlinger, 1964). The field experiment utilized a 'before-after' design for validating the e-learning module. The complete methodology for designing, testing and validating the e-module has been described as follows:

Developing an e-module required establishing a standard procedure. It comprised of information gathering about WTO with special reference to agriculture and defining basic guideline for content presentation and storyboarding. Information, regarding WTO and its agriculture related aspects, was compiled from various available sources like books, articles, research communications, internet, etc. Universe of the content was defined based on the training needs of the agricultural researchers. Web services were also used to gather different multimedia

objects relevant to the content; avoiding copyright violations. Content structuring was done considering standard principles like chunking i.e. the process of developing blocks of content around a key message, relevance i.e. emphasizing needs and interests of target learners, labeling i.e. appropriately naming a chunk, modularity i.e. standardized partitioning of content, sequencing i.e. arranging chunks; and hierarchy i.e. grouping of chunks as per level of importance. Similarly, principles followed for composing e-module are balance i.e. maintaining equilibrium to obtain harmony between objects, unity i.e. using elements that go together, repetition i.e. repeating usage of elements to emphasis an idea, variety i.e. use of different elements to avoid monotony, rhythm i.e. movement created using repetition and variety, emphasis i.e. establishing a locus of interest to draw viewer's attention; and contrast i.e. obtaining difference between elements. Storyboarding was done to obtain a combination of the content including multimedia objects into a lesson.

Developed storyboards were combined into a computer program and a prototype-module was designed using an e-learning authoring tool 'Adobe Captivate 7' (version 7.0.1.237). It was tested among randomly selected 20 agricultural scientists and 20 post graduate students of Indian Agricultural Research Institute, New Delhi. The purpose behind testing was to check suitability of the e-module to the actual end users considering various dimensions such as length of module, technical difficulties, perceived likes and dislikes, ability to meet objectives and expectations, difficulty level, etc. The data for testing were collected through questionnaire method using a semi-structured measuring instrument. The testing instrument also included usability evaluation scale for e-learning developed by Zaharias (2004). Usability evaluation was done to know appropriateness of the e-module with respect to content, learning & support, visual design, navigation, accessibility, interactivity, self-assessment & learnability, and motivation to learn. Finally, the module was published in CD-ROM format with necessary modifications.

Validation of the e-module was done to know its effectiveness in imparting learning to the intended end user. Excluding the respondents who were used for testing the e-module, knowledge of randomly selected 30 agricultural scientists and 30 agricultural post-graduate students was tested before and after the exposure to the e-module on WTO with special reference

to agriculture. The knowledge gain, the difference between pre-exposure and post-exposure knowledge test results, was attributed to the effect of the treatment i.e. exposure to the e-module.

Content validity of the measuring instrument for validation was established through a panel of thirty experts; it was ensured that the items covered all the dimensions of WTO with special reference to agriculture. Split half method was employed taking 30 non sample respondents and the coefficient of reliability obtained was 0.793.

During testing stage data were collected using a semi-structured questionnaire; whereas, data for validation were collected through personal interview method using a structured interview schedule. The collected data were analyzed using relevant statistical tools and techniques namely, arithmetic mean, percentage, frequency, standard deviation and independent sample t-test.

Results and Discussion

It should be mentioned here that the analysis of knowledge of agricultural scientists about WTO and its agriculture related issues was done using a standardized knowledge test to find out their training needs regarding WTO. The description of the mentioned study is beyond the scope of this research investigation. Whereas, identified training needs were utilized as the precursor for defining the scope of the e-module. Thus, it must be noted here that training needs analysis was considered a prerequisite for designing the e-learning module.

Designing the e-learning module on WTO issues with special reference to agriculture

The subject matter covered in the e-module was restricted to meet the training needs of the intended users. Technical words or jargons were avoided; and, commonly used words and straightforward sentences were used to keep the language of the e-learning module as simple as possible. Farm journalistic style of writing was used to attract and retain attention of the learner. More emphasis was given on practical aspects and examples of the concepts to relate the topic under discussion with the needs and interests of the end users. Using appropriate words, short and sharp titles were employed to label the ideas and concepts. Since, the e-learning module dealt with WTO and its agriculture related aspects; it was decided to partition the content into

two separate units. Thus, the e-learning module “World Trade Organization and Agriculture” actually comprised of two units namely “An Introduction to World Trade Organization” and “Agriculture in WTO”. These units were standardized parts capable of independently standing alone. A proper hierarchy was maintained while arranging the content and the graphic design.

Figure 1: E-learning module explaining Copyrights

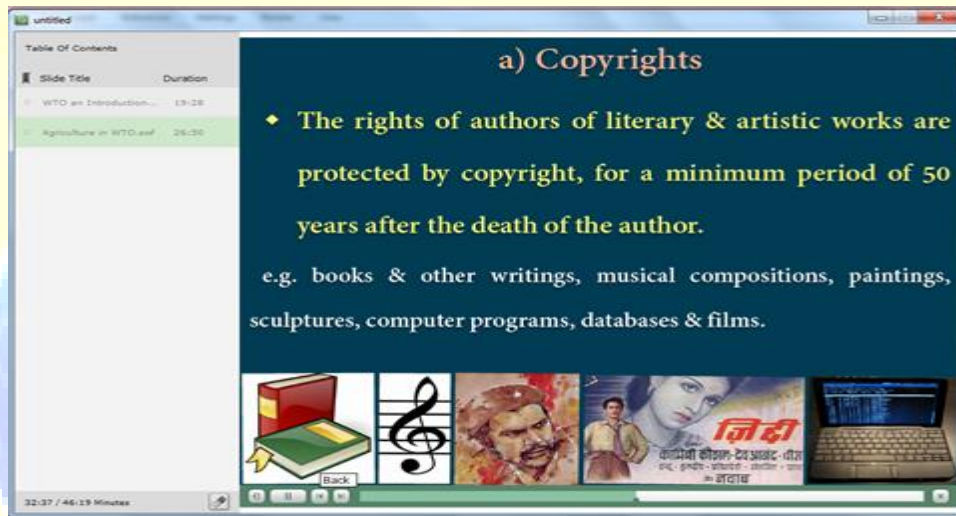
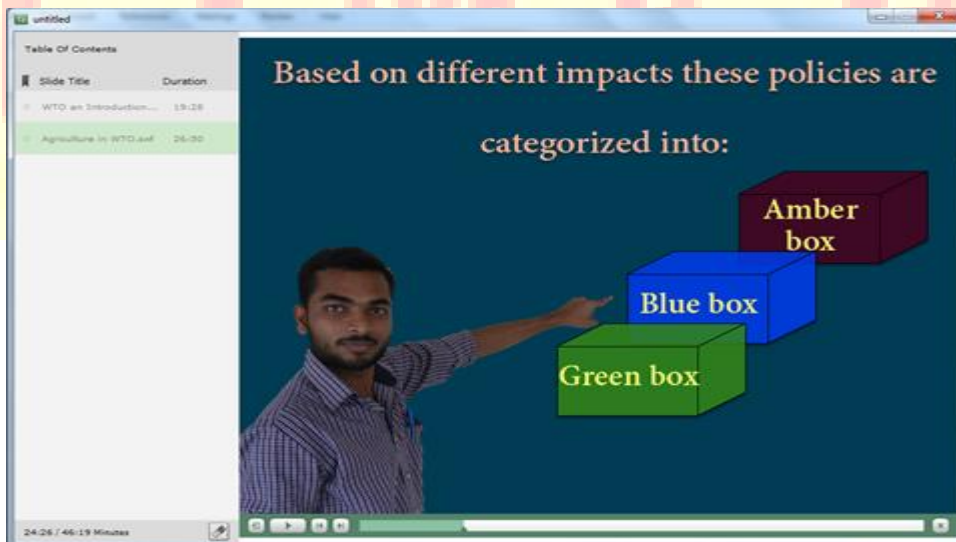


Figure 2: E-learning module categorizing domestic support policies



A balance of positive and negative shapes based on visual weights were arranged to obtain a harmonious effect. Formal balance was predominantly adopted in developing the e-module to achieve minimal perceptual loss. Similarly, to maintain harmony in a storyboard, elements used were selected based on their relevance to the idea they represent. All the elements were supposed to support each other in clarifying the idea and contribute finally to a unique style of presenting the idea. The style of presentation for similar kind of information was used repeatedly to add emphasis, to create desired effects and to establish unity in the composition. Contrarily, to avoid adverse effects of repetition and to break the monotony, a variety was incorporated in the e-module by using different colors, illustrations and font sizes. These repetitions and variety were supposed to create a visual path for giving smooth rhythmic effect for the learners. Regular rhythm was considered while designing the e-module so that the user can move quickly through the content. At the same time, the central idea of interest was highlighted every time with attractive colors, shapes and other visuals to catch and retain viewer's attention. Similarly, contrast in the designed was achieved by using variety of colors, sizes and textures. Thus, all the principles of content structuring and composition were employed while designing the e-module to attract and retain viewer's attention and ultimately to contribute to the learning experience.

Testing of the e-learning module

The e-module 'World Trade Organization and Agriculture' was tested amongst 20 agricultural scientists and 20 agricultural post graduate students of ICAR-Indian Agricultural Research Institute, New Delhi.

Testing was meant to determine the suitability of the e-module for the end users, it was therefore necessary to find out various factors that may affect learner's attention and continuance while going through e-module. Review of literature revealed few factors such as time taken to complete viewing an e-module, time when a viewer gets exhausted, length of the module, difficulty level of e-module and assessment, etc. The study analyzed all necessary factors to establish suitability of the e-module. The results revealed that the respondents spent on an average 65 minute to completely review the information from the module. However, the range of

time spent varied from 30 minutes to 90 minutes. At the same time, when respondents were asked about their time of exertion i.e. when they felt like skipping or leaving the course in between, the mean time noted was 30 minutes; whereas, it ranged from 30 to 45 minutes. Surprisingly, none of the respondents reported leaving the course before completion because the information seemed beneficial for their careers, they developed curiosity about the topic or they found information to be interestingly presented.

Table 1: Time spent by the respondents reviewing the information and time of exertion (n=40)

Sr. No.	Time	Mean time (HH:MM)	Range (HH:MM)
1	Time spent	01 : 05	00:30 – 01:30
2	Time of exertion	00 : 30	00:30 – 00:45

(HH:MM – Hour: Minute)

The length of the e-module is another aspect which may define its ability to retain interest of the learners. Though majority of the respondents (55.0 %) found the e-module to be lengthy and very few (5.0 %) found it as very lengthy; as much as 40.0 percent felt that the length of the module was appropriate. Similarly, when asked about technical difficulties like complicated functioning, improper links, failure of action buttons, etc.; 35 per cent of the respondents replied positively.

Table 2: Different aspects of e-module as perceived by the respondents (n=40)

Sr. No.	Aspect	Frequency (percentage)				
		Too lengthy	Lengthy	Appropriate	Short	Very Short
1	Length of e-module	2 (5.0 %)	22 (55.0 %)	16 (40.0 %)	0	0
2	Difficulty of e-module	0	8 (20.0 %)	26 (65.0 %)	6 (15.0 %)	0
3	Usefulness of Assessment	26 (65.0 %)	14 (35.0 %)	0	0	0
4	Difficulty of Assessment	0	14 (35.0 %)	24 (60.0 %)	2 (5.0 %)	0
5	Overall rating of e-module	22 (55.0 %)	18 (45.0 %)	0	0	0

Respondents were also asked about their perception of difficulty level of the e-module; as much as, 65.0 percent of them found e-module to be appropriately difficult. Defiantly, 20.0 percent reported it as easy and 15.0 percent as difficult. None of them perceived it as too easy or too difficult. Assessment was as an integral part of the e-module; therefore, respondents were also inquired about perceived usefulness and difficulty level of the assessment. Majority of them (65.0 %) found it to be very useful and the rest (35.0 %) found it as useful. Similarly, majority of them (60.0 %) found assessment to be of appropriate difficulty level, 35.0 percent as easy and remaining (5.0 %) as difficult. All of the respondents were affirmative when asked whether the e-module course met pre-defined objectives and learner's expectations.

Respondents, at last, were requested to rate the e-module; as much as, 55.0 percent of them rated it as very good and the rest i.e. 45.0 percent rated as good. Similarly, respondents were also asked to mention any related topic they would like to know about. Although, most felt that the information covered in the e-module was enough; few of them expressed their desire to know more about topics like recent issues concerning India at WTO, present Indian representation at WTO, procedure for filing patents and other related information about PPVFR, 2001. Likewise, few conveyed their wish to know more about TRIPS and its relevance, relevance of WTO in contemporary agriculture, more practical information about WTO, recent and practical issues of WTO, and details about farmers' rights. Thus even though the e-module had its limitations and demerits, it was found acceptable by the respondents.

It also was considered necessary to inquire about the aspects respondents liked and disliked about the e-module. Majority of the respondents (72.5 %) liked the story telling format of the e-module. Similarly, respondents liked sequencing, structure and logical flow of information (67.5 %), style of presentation and simplicity (65.0 %), visuals (57.5 %) and background set for the topic (55.0 %). Likewise, as much as 45.0 percent respondents liked adequacy of the information, content, description and conciseness; 42.0 percent liked simplicity of language, 32.5 percent liked given examples, 47.5 percent liked Multiple Choice Questions (MCQs) and 40.0 percent of them liked the ease of operation of the e-module.

Table 3: Most liked aspects of modules felt by the respondents (n=40)

Sr. No.	Aspects	Frequency	Percentage
1	Sufficient information, content, description, conciseness	18	45.0
2	Style of presentation, simplicity	26	65.0
3	Simple language	17	42.5
4	Background set for the topic	22	55.0
5	Given examples	13	32.5
6	Visuals	23	57.5
7	Sequencing, structure and logical flow of information	27	67.5
8	MCQ	19	47.5
9	Ease of operation	16	40.0
10	Story telling format	29	72.5

Table 4: Most disliked aspects of modules felt by the respondents (n=40)

Sr. No.	Aspects	Frequency	Percentage
1	Lengthy	33	82.5
2	Less interesting presentation	24	60.0
3	Long sentences	18	45.0
4	Technical terminologies	25	62.5
5	Slow pace of operation	26	65.0
6	Less visuals	19	47.5
7	Too many MCQs	10	25.0
8	Less interesting topic	34	85.0
9	Less examples	22	55.0

Contrarily, when asked about disliked aspects of the e-module, as much as 85.0 percent mentioned the topic was less interesting, 82.5 percent highlighted too much length of the e-module, 65.0 percent stated slow pace of operation, 62.5 percent talked about technological terminologies and 60.0 percent affirmed the presentation was less interesting. Other disliked features were long sentences (45.0 %), less number of visuals (47.5 %), use of too many MCQs in the assessment (25.0 %) and lesser number of examples (55.0 %). Lastly, to study different

dimensions of the e-module for its specific deployment, usability evaluation was done with the scale developed by Zaharias (2004).

Table 5: Usability evaluation of English module by the respondents (n=40)

Criteria	SA	A	N	D	SD	MS
Content						
Vocabulary and terminology used are appropriate for the learner	8 (20%)	30 (75%)	2 (5%)	0	0	4.15
Abstract concepts (principles, rules, etc.) are illustrated with concrete , specific examples	20 (50%)	20 (50%)	0	0	0	4.5
Learning & Support						
The course offers tools (taking notes, resources, etc.) that support learning	8 (20%)	24 (60%)	6 (15%)	2 (5%)	0	3.95
The course allows an individual to learn on his own	16 (40%)	20 (50%)	4 (10%)	0	0	4.3
Visual Design						
Fonts (Style, color, saturation, contrast) are easy to read	12 (30%)	22 (55%)	6 (15%)	0	0	4.15
Navigation						
Learner always knows where he is in the course	14 (35%)	24 (60%)	2 (5%)	0	0	4.3
The course allows the learner to leave whenever desired, but easily return to the closest logical point in the course	14 (35%)	14 (35%)	10 (25%)	2 (5%)	0	4
Accessibility						
The course is free from technical problems (hyperlink errors, programming errors, etc.)	16 (40%)	12 (30%)	4 (10%)	4 (10%)	4 (10%)	3.8
Interactivity						
The course uses elements that gain attention and maintain motivation of the learner	12 (30%)	18 (45%)	8 (20%)	2 (5%)	0	4
Self-assessment and Learnability						
Learner can successfully start, learn, complete the	16	20	4	0	0	4.3

entire course and test what he learned using only given instructions	(40%)	(50%)	(10%)			
Motivation to learn						
The course incorporates novel characteristics	6 (15%)	28 (70%)	6 (15%)	0	0	4
The course stimulates further inquiry	12 (30%)	20 (50%)	8 (20%)	0	0	4.1
It is enjoyable and interesting	14 (35%)	18 (45%)	6 (15%)	2 (5%)	0	4.1
It provides learner with frequent and varied learning activities that increase learning success	12 (30%)	22 (55%)	4 (10%)	2 (5%)	0	4.1
Average						4.125

(SA-Strongly agree, A-Agree, N-Neutral, D-Disagree, SD-Strongly disagree, MS-Mean Score)

Usability evaluation involved study of different aspects of the e-module like content, supports, visual design, navigation, accessibility, interactivity, self-assessment, learnability and motivation to learn. Amongst the respondents, 75 percent agreed and 20 percent strongly agreed that vocabulary and terminology used were appropriate for the learners. Similarly, half of the respondents strongly agreed and rest half agreed that the abstract concepts were illustrated with concrete and specific examples. When asked about learning and support, 60 percent of respondents agreed and 20 percent strongly agreed that the course offered tools that support learning; and, 40 percent strongly agreed and 50 percent agreed that the course allowed an individual to learn on his own. Likewise, majority of the respondents (55 %) agreed and 30 percent strongly agreed that the visual design i.e. fonts, were easy to read considering their style color, saturation and contrast. Majority of respondents (60 %) agreed and 35 percent strongly agreed that a learner always knew where he was in the course at a point of time. Whereas, when asked about whether the course allowed a learner to leave whenever desired and return to the closest logical point in course, 35 percent strongly agreed and 35 percent agreed; at the same time, 25 percent were neutral and five percent disagreed. Moreover, respondents faced problems in accessibility, when asked about course being free from technical issues such as hyperlink errors, programming errors, etc. 40 percent strongly agreed and 30 percent agreed, but 10 percent were in neutral, disagree and strongly disagree category each. When inquired about interactivity,

30 percent strongly agreed and 45 percent agreed that the course uses such elements that catch attention and maintain motivation of the learner. Contrarily, 20 percent were neutral and five percent disagreed to the statement. Majority of the respondents (50 %) agreed and 40 percent strongly agreed that using given instructions a learner can successfully start, learn, complete the entire course and test what he has learned. Similarly, about e-module's ability to motivate learning, as many as, 70 percent of the respondents agreed and 15 percent strongly agreed that the course has included novel characteristics. Similarly, 50 percent agreed and 30 percent strongly agreed that the course stimulated further inquiry. About module being enjoyable and interesting, 35 percent strongly agreed and 45 percent agreed; whereas, 15 percent were neutral and five percent disagreed. Likewise, majority of the respondents (55 %) agreed and 30 percent strongly agreed that the e-module provides learner with frequent and varied learning activities that increase learning success; on the contrary, 10 percent were neutral and five percent disagree. While looking at the response as a whole, the overall mean score of usability evaluation 4.125 signifies a strong agreement among the respondents about effectiveness of the e-module.

Validation of the e-module on World Trade Organization with special reference to agriculture

Based on the feedback on testing, the module was revised and then validated. The validation of the e-module was done with 30 agricultural scientists and 30 post-graduate students of agriculture as learner respondents. The knowledge gain i.e. the difference between pre-test and post-test knowledge scores of the respondents, was considered as the outcome of exposure to the e-module.

Table 6: Comparison of knowledge levels of respondents before and after exposure to the e-module (n=60)

Dimensions	Pre-test score		Post-test score		Mean difference (X 2- X 1)	Knowledge gain (%)	Calculated t- test
	Mean	SD	Mean	SD			
	(X 1)	1	(X 2)	2			
1) Evolution and objectives of WTO	3.10	0.76	3.73	0.45	0.63	20.43	4.5*
2) Structure and functions of WTO	0.53	0.51	2.63	0.49	2.10	393.75	17.3*

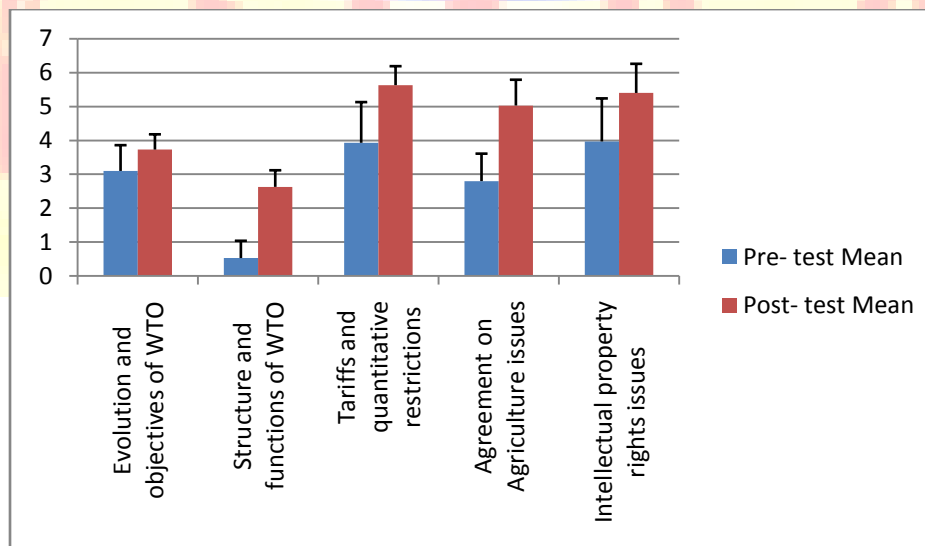
3) Tariffs and quantitative restrictions	3.93	1.20	5.63	0.56	1.70	43.22	8.8*
4) Agreement on Agriculture issues	2.80	0.81	5.03	0.76	2.23	79.76	14.2*
5) Intellectual property rights issues	3.97	1.27	5.40	0.86	1.43	36.13	6.2*
Overall	19.53	6.31	28.34	3.17	8.80	56.51	12.6*

(SD- Standard Deviation)

*significant at 1% level of significance

The comparison revealed that the knowledge gain of 20.43 percent was observed in terms of dimension 'Evolution and objectives of WTO'. The highest knowledge gain of 393.75 percent was experienced in 'Structure and functions of WTO' dimension. 'Tariff and quantitative restrictions' dimension detected knowledge gain of 43.22 percent. Similarly, dimensions 'Agreement on Agriculture issues' and 'Intellectual Property Rights issues' experienced knowledge gain of 79.76 percent and 36.13 percent respectively. Thus, a total of 56.51 percent overall knowledge gain was recorded after exposure to the e-module.

Graph 1: Comparison of knowledge levels of respondents before and after exposure to the e-module on WTO with special reference to agriculture



The results also revealed that there was a significant difference between pre-test and post-test knowledge scores of the respondents on all the dimensions of WTO namely 'Evolution and objectives of WTO'; 'Structure and functioning'; 'Tariff and quantitative restrictions'; 'Agreement on Agriculture' and 'Intellectual property rights'.

Implications

Human interaction in many teaching situations is invaluable (Brandabur, 2011), besides e-learning is not considered as a substitute for a good teacher; efforts should be made to design attractive and interactive e-modules to get learners motivated for effective learning. The present study implicates that brief and precise e-learning modules covering one small topic at a time would prove to be very effective in getting and maintaining motivation of the learners. Since, the study revealed mean exertion time to be half an hour at the most, the e-learning modules must be as concise as possible to be effective. Large topics must be divided into parts covering individual aspect of the subject matter independently. Sung (2014) suggested use of well-designed and appropriately applied e-learning for agricultural education. Since agricultural education stresses hands-on experience and lab activities, research should focus on different content types in various agricultural disciplines and its relationship with learning outcome.

Respondents' appreciation of simplicity and storytelling format; and, disapproval of technical terminologies, unappealing topic and impracticality implicate use of concrete concepts of immediate application for developing e-learning modules. Relevant visuals, examples, self-assessment and other similar features are necessary for quick understanding of the concepts; moreover, they have enormous impact on learners' motivation. Testing and usability evaluation indicate need and importance of target segmentation before designing any e-learning material. End user must always be kept in mind before taking any decision about designing the e-module. Otherwise, the e-module may be considered as irrelevant, impractical, unattractive and unwanted; it may fail to motivate learners even to begin with. E-learning modules, when designed properly, can have the ability not just to answer the existing questions but also to promote inquiry, critical thinking and imagination. Thus, they can be effectively used as a handy tool by the trainers and teachers for inspiring curiosity among learners.

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