A STUDY ON THE KNOWLEDGE GAIN RELATED TO SKILLS, KNOWLEDGE RETENTION AND SYMBOLIC ADOPTION USING EXPERT SYSTEM AMONG RUBBER GROWERS

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Abstract

Artificial intelligence based computer programmes called Expert System has received a great deal of attention throughout the world, due to its impressive problem solving capability in a variety of fields. For the present study, an Expert system RUBEXS-04 was designed to simulate the pest and disease diagnosing behaviour of human expert in rubber trees.

The RUBEXS-04 thus developed was tested for its relative effectiveness over four other different treatments such as human experts without discussion, human experts with discussion, RUBEXS-04 without discussion and RUBEXS-04 with discussion, using the multiple randomized design. The four treatments were allotted to 12 experimental groups to find out the relative effectiveness of the four selected treatments in terms of knowledge related to skill acquision, knowledge retention and symbolic adoption.

The findings revealed that the mean knowledge gain related to skill was maximum when the subjects were exposed to RUBEXS-04 with discussion (Ts^4). The highest mean knowledge retention was observed when the subjects were exposed to RUBEX-04 with discussion (Tr^4). Besides the treatment RUBEXS-04 with discussion (TSA^4) secured the highest symbolic adoption score among all the four treatments.

Dynamics of socio-economic development and effective transfer of technology requires a wide array of human skill. As agricultural technology is constantly subjected to metamorphosis over years, farmers are swamped with many new cultivators, pesticides and farming techniques. In order to make prudential and accurate decisions, farm managers/extension workers/farmers need speedy access to advices on agricultural problems which should be timely, reliable and consistent.

It is in this context of information age, that the development in information and communication technology may reduce the dependence on other actors in the extension stream. Our extension strategy should no longer depend on conventional extension methods like demonstration, training, radio and television broad casts.

It should make a radical shift to computer based information technology in agricultural extension (FAO, 1993; Zijp, 1994). Knowledge based Computer Programmes or Expert system containing "expert knowledge" is one such information service that would bring about a significant change in agriculture, in terms of reduced costs, increased storage, early usage and speedy access.

With this background, a study was undertaken with the following objectives.

1 To study the effectiveness of the treatments in terms of knowledge gain related to skill practice, among rubber growers.

2 To study the effectiveness of the treatments in terms of retention and symbolic adoption among rubber growers.

Materials and Methods

A Computer based Expert System for rubber protection technologies was developed by employing knowledge engineering methodology and software engineering. Under knowledge engineering methodology an exhaustive knowledge base on 44 items on plant protection technology of rubber including leaf, stem, root diseases, non microbial maladies and pests of rubber were acquired, and the documented knowledge was analysed and grouped in a common knowledge base.

Under software engineering methodology the programming language Visual Basic 6.0 was chosen for designing and developing the Expert

System on rubber. This expert system was named as RUBEXS-04, since the numerical value of 04 indicated the year of designing *i.e.* 2004. The RUBEXS-04 was programmed using Visual Basic 6.0. It is a Graphical User Interface, which uses graphics to organize workspace and also uses Event Driven Architecture.

The service area of Rubber Board Regional Office, Mannarkkad, Kerala state, India formed the locale of the study. Out of the 60 existing Rubber producers societies in the service area, three Rubber producers societies were randomly selected. From each society 40 rubber growers were selected randomly. Thus a total number of 120 rubber growers formed the sample for the study.

Multiple group randomized design was adopted in this study. Four different treatments such as human experts without discussion, human-experts with discussion, RUBEXS-04 without discussion and RUBEXS-04 with discussion was selected by the researcher. These treatments were tested for their relative effectiveness using the multiple group randomized design. Each treatment was replicated thrice. Considering 10 respondents per replication, there were 30 respondents per treatment. The 120 respondents formed the subjects for the four treatments. 'Before-After' technique of measurement was used to find out the effect of a particular treatment.

Statistical techniques such as smple percentage analysis, paired 't' test, McNemar test and Kruskal Wallis test were used, to analyse the data.

Results and Discussion

A perusal of Table 1 showed the effectiveness of the various treatments in terms of knowledge gain related to skill practice. The knowledge related to skill practices of plant protection aspects in rubber crop was exposed to the subjects through four treatments namely, human expert without discussion (Ts^1), human expert with discussion (Ts^2), RUBEXS-04 without discussion (Ts^3) and RUBEXS-04 with discussion (Ts^4). The knowledge level of the subjects related to skill was assessed before and after exposing the treatments to the subjects. Paired 't' test was applied to find out whether there was any significant difference among four treatments in terms of knowledge gain related to sill. It is observed from the Table 1 that all the four treatments difered distinctly in terms of knowledge relating to the skill practices as indicated by the highly significant 't' value.

Table 1
Mean knowledge gain related to skill due to exposure to the treatments
(n=30 per treatment)

S.No.	Treatment	Mean knowledge score				
		Before exposure	Immediately after exposure	Mean knowledge gain related to skill	Per cent of knowledge gain related to skill	't' value
1	Human expert without discussion (Ts^1)	3.00	6.83	3.83	38.30	-6.040**
2	Human expert with discussion (Ts^2)	3.23	7.66	4.43	44.30	-5.834**
3	RUBEXS-04 without discussion (Ts^3)	3.13	6.83	3.70	37.00	-9.890**
4	RUBEXS-04 with discussion (Ts^4)	4.30	8.96	4.66	46.00	-9.357**

**Significant at 0.01 level

The mean knowledge gain related to skill was maximum with a score of 4.66 which accounts for 46.60 percent of the knowledge gain related to skill when the subjects were exposed to RUBEXS-04 with discussion (Ts^4). Human expert with discussion (Ts^2) with the mean score of 4.43, human expert without discussion (Ts^1) with the score of 3.83 and RUBEXS-04 with discussion (Ts^3) with a score of 3.70 which accounted for 44.30 percent, 38.30 percent and 37.00 percent of the knowledge gain related to skill respectively.

The significance of knowledge gain related to skill caused by each treatment was confirmed by McNemar test as given in Table 2. It is

Table 2
Significance of change in knowledge gain related to skill among the experimental groups
(n=30 per treatment)

Type	Change	Treatments			
		T_1	T_2	T_3	T_4
A	Subjects who had adequate (+,-) knowledge before exposure and lost after exposure	0 (0)	0 (0)	0 (0)	0 (0)
B	Those who had adequate (+,+) knowledge before and after	0 (0)	0 (0)	0 (0)	0 (0)
C	Those who did not possess (-,-) adequate knowledge before and after	5 (16.67)	3 (10.00)	8 (26.67)	1 (3.33)
D	Those who did not possess (-,+) adequate knowledge initially but gained adequate knowledge due to exposure to treatments	25 (83.33)	27 (90.00)	22 (73.33)	29 (96.67)
	X2 value (McNemar test)	21.33**	24.03**	13.88**	28.03**

** *Significant at 0.01 level*
Figures in the parethesis indicate percentage

seen from the table that more number of subjects (96.67 %) had gained knowledge related to skill when they were exposed to RUBEXS-04 with discussion (Ts^4) compared to other three treatments. In the treatment Ts^2, the percentage of subjects who changed their knowledge level was 90.00, followd by Ts^1 with 83.33 percent whereas the least knowledge related to skill (73.33 %) was gained when the subjects were exposed to Ts^3.

Relative Effectiveness of Different Treatments in Terms of Knowledge Gain Related to Skill Practice

The relative effectiveness of the selected treatments was assessed by applying the analysis of variance technique and the results are furnished in Table 3.

Table 3
Analysis of variance for knowledge gain related to skill between the treatments

(n=120)

Source of variation	Degrees of freedom	Sum of squares	Mean squre	'F' value
Treatment	3	67.092	22.364	10.285**
Error	116	252.233	2.174	
Total	**119**	**319.325**		

** *Significant at 0.01 level*
C.D = 0.61

It is observed from the Table 3 that there existed significant difference among the four selected treatments in imparting the knowledge related to skill as indicated by the significant 'F' value at 1 percent of probability.

The critical difference for the treatments was 0.61 and hence it showed a significant difference among the treatments with respect to their relative effectiveness in imparting the knowledge related to skill. The mean scores of the four treatments were found to be in the order of :

Ts^4	Ts^2	Ts^1	Ts^3
4.66	4.43	3.83	3.70

The user friendly and less time required to acquire the operational skill of RUBEXS-04 along with discussion to clarify the doubts of the subjects, might have attracted the subjects to this treatement, and thereby gain more knowledge related to skill, compared to other treatments.

The analysis of mean for different treatments in terms of knowledge gain relating to skill practice was studied by using Krusal Wallis test of knowledge gain and the results are presented in Table 4.

Table 4
Analysis of mean rank for knowledge gain related to skill due to exposure to the treatment

S.No.	Treatments	Sample size of experimental group	Mean rank	X^2 value
1	Human experts without discussion	30	50.73	23.30**
2	Human experts with discussion	30	69.87	
3	RUBEXS-04 without discussion	30	49.07	
4	RUBEXS-04 with discussion	30	79.33	

** *Significant at 0.01 level*

It is observed from the Table 4 that all the four selected treatments differ significantly in their effectiveness in terms of knowledge gain related to skill practice. Among the four treatments, RUBEXS-04 with discussion (Ts^4) was found to be superior and most effective in imparting the knowledge related to skill with regard to plant protection aspects in rubber crop. RUBEXS-04 (Ts^3) was the least effective among other treatments.

Effectiveness of Treatments in Terms of Knowledge Retention

It could be observed from Table 5 that the highest mean retention of knowledge score of 4.92 (23.43 %) was of subjects exposed to Tr^4. This was followed by the treatment Tr^2, Tr^3 and Tr^1 which had the mean

Table 5
Mean knowledge retention after 15 days due to exposure to different treatments
(n=30 per treatment)

S.No.	Treatment	Mean knowledge score				't' value
		Before exposure	Immediately after exposure	Mean knowledge gain related to skill	Per cent of knowledge gain related to skill	
1	Human expert without discussion (Tr^1)	6.86	7.64	0.78	3.71	-3.746**
2	Human expert with discussion (Tr^2)	7.26	9.12	1.86	8.86	-2.868**
3	RUBEXS-04 without discussion (Tr^3)	6.33	8.08	1.75	8.33	-2.174**
4	RUBEXS-04 with discussion (Tr^4)	8.43	13.35	4.92	23.43	-7.969**

**Significant at 0.01 level*

retention scores of 1.86 (8.86 %), 1.75 (8.33 %) and 0.78 (3.71 %) respectively. These four treatments were also found to be significant at one percent level in respect of mean knowledge retention after 15 days. This was indicated by the significant 't' value.

Proportion of Information Retained and Forgotten by Subjects of Various Experimental Groups

The retention of knowledge after 15 days of exposure was assessed and those scores were compared with the quantum forgotten. The mean values and percentages are presented in Table 6. It is observed from the table 6 that the treatment Tr^4 (RUBEXS-04 with discussion) had the highest retention of knowledge gained (72.35%) followed by treatment Tr^3 (65.64%) followed by treatment Tr^2 (46.85%) and lastly by treatment Tr^1 (Human expert without discussion) (28.47%).

Table 6
Mean knowledge retained and forgotten after 15 days of exposure to treatments
(n=30 per treatment)

S.No.	Treatments	Mean gain in knowledge	Quantum retained after 15 days	Quantum forgotten after 15 days
1	Tr^1	2.74	0.78 (28.47)	1.96 (71.53)
2	Tr^2	3.97	1.86 (46.85)	2.11 (53.15)
3	Tr^3	2.67	1.75 (65.54)	0.92 (34.46)
4	Tr^4	6.80	4.92 (72.35)	1.88 (27.65)

In other words, the quantum of forgetfulness was higher in treatment Tr^1 (Human expert without discussion) and lowest in treatment Tr^4 (RUBEXS-04 with discussion).

The analysis of variance techniques was applied to find out the relative effectiveness of selected treatments in terms of knowledge retention and the results are presented in Table 7. A perusal of table 7 revealed that there was significant difference between the treatments with regard to knowledge retention 15 days after exposure to treatments. It was indicated by the significant 'F' value at 1percent level of probability. The critical difference for the treatment was 2.35. The mean score of the knowledge retention of the four treatments were of the order of :

Tr^4	Tr^2	Tr^1	Tr^3
4.92	1.86	1.75	0.78

Table 7
Analysis of variance for knowledge retention between the treatments

(n=120)

Source of variation	Degrees of freedom	Sum of squares	Mean square	'F' value
Treatment	3	423.153	28.210	2.811**
Error	116	1043.772	10.036	
Total	**119**	**1466.925**		

** *Significant at 0.01 level*
C.D = 2.35

These results indicate that all the treatments were effective, but distinctly different in terms of knowledge retention. The treatment Tr^4 was found to be superior and most effective in terms of knowledge retention compared to all other three treatments.

The finding is also in agreement with Sundaraswamy and Rao (1977) who reported that there existed a significant difference between knowledge level immediately after exposure to farm telecast and 15 days after telecast.

In order to find out the mean rank for different treatments in terms of knowledge retention, Kruskal Wallis test was applied to find out the mean rank of the individual treatments. The results are presented in Table 8.

Table 8
Analysis of mean rank for knowledge retention due to exposure to the treatments

S.No.	Treatments	Sample size of experimental group	Mean rank	X^2 value
1	Human experts without discussion	30	44.18	44.86**
2	Human experts with discussion	30	53.75	
3	RUBEXS-04 without discussion	30	47.88	
4	RUBEXS-04 with discussion	30	96.18	
	Total	**120**		

** *Significant at 0.01 level*

It could be inferred from table 8 that there exists a significant difference in terms of knowledge retention among the selected four treatments. This is evident from the highly significant X^2 value.

The results also indicated that there was retention of knowledge 15 days after the exposure to treatments.

Relative Effectiveness of the Treatments in Terms of Symbolic Adoption

The analysis of variance was applied to find out the relative effectiveness of the selected four treatments with regard to symbolic adoption and the results are presented in Table 9. It is observed from the table 9 that there is no significant difference between the selected four treatments in influencing the symbolic adoption of the plant protection aspects in rubber crop. This was indicated by the non-significant 'F' value. This might be due to the fact that the presentation through these treatments would have transferred the technology inducing the subjects symbolic adoption evenly. The mean score of the four treatments with respect to smbolic adoption are presented below.

TSA^4	TSA^2	TSA^3	TSA^1
7.44	7.20	7.00	6.92

Table 9
Analysis of variance for symbolic adoption between the treatments

(n=120)

Source of variation	Degrees of freedom	Sum of squares	Mean square	'F' value
Treatment	3	10.625	3.542	1.156 NS
Error	116	355.367	3.064	
Total	**119**	**365.992**		

NS - Non Significant
C.D = 0.294

The results indicate that the treatment namely RUBEXS-04 with discussion (TSA^4) secured the highest symbolic adoption score followed by TSA^2, TSA^3 and the least symbolic adoption by TSA^1 (Human expert without discussion). These findings are in conformity with the findings of Sathyaseelan (1998) and Anandaraja (2002) who reported that there was no significant association between the use of extension methods and symbolic adoption behaviour of farmers.

Conclusion

The findings of the study have proved beyond doubt that the Expert System (RUBEXS-04) with discussion had been most effective in transferring the critical Rubber protection technologies to farmers. This is evinced by the fact that RUBEXS-04 with discussion had proved to

be the most effective in terms of knowledge gain related adoption, among the treatment studied.

In the current age of computer-based information technology, the use of Expert Systems in catering to the needs of the cognitive domain of the farmers and favourably influencing their conative domains is the best alternative to ensure speedier and effective transfer of farm technologies.

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