

A Study on User Interface Design of Knowledge Management Groupware in Selected Leading Organizations of Pakistan

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Abstract. Several techniques for evaluating a groupware interface have emerged in recent years. Though a groupware is considered to be difficult to evaluate, many researchers to date have attempted to uncover the usability problems of the interface using multiple evaluation methods or triangulation running parallel to each other. The aims of this paper are to compare the effectiveness of dual evaluation methods such as Usability Testing and Heuristic Evaluation on different groupware products in the organizations of Pakistan and to manifest the user's preference for an ideal interface. Because of the paucity of resources, the user based and inspection based techniques couldn't be carried out in other parts of Pakistan where the IT industry has mushroomed in the past few years. Nevertheless these restrictions didn't significantly affect from validity of the findings. Upon comparing the results from the two Usability Evaluation Methods (UEM), we concluded that both UEMs were equally efficient in identifying potential usability problems.

Keywords. Usability evaluation methods, Heuristic evaluation, Usability testing, Groupware.

1. Introduction

There are a variety of Knowledge Management (KM) tools which make communication and collaboration among geographically dispersed staff possible. The collaboration tools help people work together and share the information that has been managed by Knowledge Management. KM systems tend to fail in the absence of effective user interface design, regardless of the value of knowledge stored in it. A good user interface is an improved technology that allows users to effectively perceive and express information. The interface design plays a great role in increasing the team productivity of work and presents information to users with more accuracy and a higher level of control.

Software tools that aid in communications and collaboration are included within knowledge management because of their role in facilitating the flow of tacit information (Nonakia and Takeuchi, 1995). Groupware is simply a collaboration tool that helps people work together more easily or more effectively. It typically allows them to communicate, coordinate and collaborate (Hills, 1997). Groupware interface has been an area of great concern for many researchers as it is considered difficult to evaluate because of its multiple-user nature. Numerous researches have been done using single evaluation and multiple evaluation methods including both inspection based techniques and user based techniques. In spite of that, there are no set standards for using any particular technique. Evaluating a groupware interface is an evolving process and requires more investigation on the suitability of techniques applied in different culture contexts.

Usability Evaluation (UE) consists of methodologies for measuring the usability aspects of a system's user interface

(UI) and identifies specific problems (Dix et al., 1998 and Nielson, 1993). A Usability Problem (UP) is defined as a flaw in the designing of a system that makes the attainment of a particular goal with the use of the system ineffective and/or inefficient, and thus lowers the user's level of satisfaction with its usage. Until now, a number of researches have been carried out comparing the effectiveness of different UEMs. (Bailey et al., 1992; Jeffries et al., 1991; Karat et al., 1992; Desurvire, 1994; Jorgensen, 1999).

Complementary methods, converging measures, and triangulation are embraced by most social science methodologists (Law and Hvannberg, 2002; Eisner and peshkin, 1990; Sullivan, 1991; Yin, 1984). Based on the research studies done earlier it has been found that Heuristic evaluation (HE) and usability testing (UT) complemented each other (Gutwin et al., 2001) and proved to be a good combination to uncover minor and major software bugs. The reason for adopting multiple methods is to assemble evidence from more than one source of information. The combined use of these two methods would reveal many hidden problems, which might be overlooked when one technique is used.

In the remainder of this paper, the main results of the evaluations are drawn and compared. We also highlight the highest rated and least rated usability problems within each organization.

2. Objectives and Scope

This study sought to identify usability problems of the KM groupware used by the selected leading organizations in Pakistan. It also tried to determine the usability problems of groupware interface by conducting the heuristic evaluation technique, that is, to judge its compliance with Jakob

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Nielsen's ten heuristics. Similarly it determined the usability problems of groupware interface by applying the usability testing method.

At the end, this study attempted to compare the results of the two methods and derived some conclusions on the effectiveness of each technique: user-based technique vs. the inspection method.

Standard procedures based on UT and HE literatures were adopted when conducting both techniques. The research was conducted in companies belonging to different corporate sectors in Pakistan. The companies covered in Pakistan were Askari Commercial Bank (ACB), LMK Resources (LMKR) and Enterprise Technology Pvt. Ltd (ETPL). The only consideration for selecting the organization was the availability of groupware product. Table 1 shows the companies selected and the groupware product in use.

Table 1. Company profiles

Company	Groupware Product
LMK Resources	Lotus Notes
Askari Commercial Bank	Askari In-house product
Enterprise Technologies Pvt. Ltd.	Simex (In-house product)

The recommended number of evaluators for a HE is between three and five, given that the informational gain with an additional evaluator drastically decreases after the fifth one and that the benefit-cost ratio is highest when three or four evaluators are employed (Nielsen, 1994). But in this study the number of Evaluators for HE was two instead of the traditional three to five. This is supported again by Nielsen's (1995) theory that found that the highest percent of the respondents employed two evaluators for HE, although they were instructed to use three to five. Similarly based on Nielsen's theory, Law and Hvannberg (2002) involved only two evaluators for HE in their multiple method study.

3. Method and Results

3.1. Heuristic evaluation assessment

HE was performed on the user interface design of groupware by two evaluators (E1 and E2) taken from each organization. Both inspectors performed the evaluation independently and afterwards an average of the usability problems identified by them was obtained. The inspectors were given considerable freedom on how and when they perform their task, quite similar to Nielsen's practice of conducting HE. Since the evaluators were taken from the organization itself, there was no issue of non-familiarity with the groupware product. The inspection method identified several potential UP in the groupware interface. The three most obvious or highly rated UP found within each organization have been highlighted and discussed. Table 2 depicts the profile of the selected evaluators for HE within each organization.

Table 2. Profile of the Evaluators for HE

Co.*	Eva*	Designation	Age	Exp.*
ETPL	E1	Senior Programmer	26	10 years
	E2	Software Engineer	28	5 years
LMKR	E1	Testing Analyst	26	11 months
	E2	Testing Analyst	26	2 years
ACB	E1	Junior officer	21	2 years
	E2	Junior officer	28	1 year

Note: *Co= Company, *Eva= Evaluator & *Exp= Experience of working

Table 3 shows the percentage of usability problems (UP) identified by each evaluator in Enterprise Technologies Pvt. Ltd and the average percentage is shown in the third column. In ETPL, where an in-house developed groupware SIMEX (secure internet message exchange) is being used, the evaluation of the interface exposed more than 50% of the usability problems in the 'error prevention', 'help and documentation' and 'recognition rather than recall' areas. This implies that one of the main problems with the interface is that it does not provide features that can prevent users from committing errors during the interaction. Help and documentation was not provided in details for the ease of use of the system. Another usability problem issue is pertaining to the instructions for the use of the systems, which were neither visible nor retrievable to the users.

Table 3. Results of Heuristic Evaluation at Enterprise Technologies Pvt. Ltd.

HEURISTICS	E 1	E 2	Ave*
Error Prevention	80%	50%	65%
Help and Documentation	57%	50%	54%
Recognition Rather Than Recall	50%	55%	53%
Visibility of System Status	43%	50%	47%
Aesthetic and Minimalist Design	44%	40%	42%
Match Between System and the Real World	40%	30%	35%
User Control and Freedom	33%	33%	33%
Help Users Recognize, Diagnose, and Recover From Errors	33%	30%	32%
Consistency and Standards	36%	25%	31%
Flexibility and Minimalist Design	29%	30%	30%

Note: *Ave= Average

The HE of Lotus Notes at LMK Resources shows that more than 50% of the usability problems found were related to 'match between the system and the real world', 'recognition rather than recall' and 'visibility of the system's status'.

Usability problems found related to having a less logical order of the information and system oriented terms rather than user-oriented terms. Another problem was with instructions for use, which were less visible and retrievable. Yet another usability problem which cannot be ignored, shows that the system doesn't keep the users informed about the action taken and doesn't give appropriate feedback with in the given time.

Table 4. Results of Heuristic Evaluation at LMK Resources

HEURISTICS	E 1	E 2	Ave*
Match Between System and the Real World	75%	57%	66%
Recognition Rather Than Recall	69%	50%	60%
Visibility of System Status	58%	47%	53%
Error Prevention	75%	25%	50%
Help Users Recognize, Diagnose, and Recover From Errors	64%	36%	50%
Aesthetic and Minimalist Design	67%	22%	45%
Consistency and Standards	55%	32%	44%
Help and Documentation	75%	5%	40%
Flexibility and Minimalist Design	0%	57%	29%
User Control and Freedom	0%	25%	13%

Note: *Ave=Average

Similarly, another pair of evaluators from the Askari Commercial Bank inspected their bank's in-house developed groupware and the results derived from their evaluation are summarized in Table 5.

As shown in table a majority of the usability problems (more than 50%) lie with the 'Help users recognize, Diagnose, and Recover From Errors' and 'visibility of the system's status'. The interface of the groupware displayed the error messages using complicated terms rather than plain language. This aspect of interface problem stated that recovery from error and appropriate error messages were not provided in most of the cases. It neither indicates the problem precisely nor does it give a constructive solution. Another weak aspect of the interface found by the evaluators was that the system doesn't keep the user informed about the processes while running their tasks and appropriate feedbacks of their operations.

Table 5. Results of Heuristic Evaluation at Askari Commercial Bank

HEURISTICS	E 1	E 2	Ave*
Help Users Recognize, Diagnose, and Recover From Errors	63%	40%	52%
Visibility of System Status	33%	67%	50%
Aesthetic and Minimalist Design	33%	60%	47%
User Control and Freedom	20%	67%	44%
Error Prevention	38%	50%	44%
Flexibility and Minimalist Design	17%	67%	42%
Recognition Rather Than Recall	24%	58%	41%
Help and Documentation	19%	50%	35%
Consistency and Standards	26%	25%	26%
Match Between System and the Real World	29%	0%	15%

Note: *Ave= Average

Table 6 highlights the usability problems identified using the HE method at each organization. The last row in the table shows the average percentage of all usability problems obtained from each organization. LMK Resources having Lotus Notes as their groupware product showed a higher percentage of usability problems than Enterprise's SIMEX and Askari's in-house product. But none of the total usability problems found in the interface of the three products exceeded

50%. Each product had a few high percentages of interface related problems pertaining to certain aspects.

Table 6. Comparison of the results of HE among Enterprise Technologies Pvt. Ltd. (ETPL), LMK Resources (LMKR) and Askari Commercial Bank (ACB)

HEURISTICS	ETPL	LMKR	ACB
Visibility of the System Status	47%	53%	50%
Match Between System and the Real World	35%	66%	15%
User Control and Freedom	33%	13%	44%
Consistency and Standards	31%	44%	26%
Error Prevention	65%	50%	44%
Recognition Rather than Recall	53%	60%	41%
Flexibility and Minimalist Design	30%	29%	42%
Aesthetic and Minimalist Design	42%	45%	47%
Help User recognize, diagnose, and recover from errors	32%	50%	52%
Help and documentation	54%	40%	35%
AVERAGE	42 %	45 %	40 %

3.2. Usability testing assessment

The previous section shows the results of HE. This section presents findings on usability problems using the UT method. We limited the number of people who could participate in the usability testing to five participants from each organization. Their evaluation of the groupware's interface was based on the guidelines for User Interface Design developed by Hix and Hartson (1993). The participants in the UT were different from those in the inspection-based technique and were unaware of the results of that evaluation. Table 7 shows the profile of the UT participants at each organization.

Table 7. Profile of the Participants (P 1-P 5) for UT

Co.*		Designation	Age	Exp* (Years)
ETPL	P1	Programmer	24	4
	P2	Senior Programmer	25	5
	P3	Programmer	25	2
	P4	Senior Programmer	27	4
	P5	Software Programmer	26	3
LMKR	P1	Software Engineer	27	4
	P2	Network Administrator	27	5
	P3	Testing Analyst	26	2
	P4	Software Programmer	24	3
	P5	Software Programmer	24	2
ACB	P1	Junior officer	21	2
	P2	Junior officer	28	1
	P3	Senior officer	31	5
	P4	Programmer	25	2
	P5	Programmer	27	4

Note: *Co= Company & *Exp=Experience of working

Table 8 shows the evaluation of interface by five participants at Enterprise Technologies Pvt. Ltd. The average result is shown in the last column. The highest percentages of usability problems found were related to ‘individual differences’, ‘cognitive directness’, and ‘attention’. The Usability problem found indicates that the system’s interface had lesser customization facility of screen layouts, which doesn’t accommodate individual difference in user experience. Though it is not preferable to use attention-grabbing techniques but these were over used to some extent. The users also underscored in their evaluation the over usage of less meaningful icons and letters.

Table 8. Results for Usability Testing at Enterprise Technologies Pvt Ltd.

Usability Guidelines	P 1	P 2	P 3	P 4	P 5	Ave *
Individual Differences	100 %	100 %	100 %	100 %	100 %	100 %
Cognitive Directness	100 %	0%	100 %	100 %	100 %	80%
Attention	67%	100 %	67%	67%	33%	67%
Color Scheme	50%	40%	60%	40%	40%	46%
Feedback	33%	67%	33%	33%	33%	40%
Display Issues	40%	0%	50%	40%	40%	34%
Human Memory Limitation	50%	0%	50%	25%	0%	25%
Simplicity	33%	0%	33%	33%	0%	20%
System Messages	0%	50%	0%	0%	25%	15%
Consistency	0%	20%	0%	0%	0%	4%
Modality	0%	0%	0%	0%	0%	0%
Anthropomorphization	0%	0%	0%	0%	0%	0%

Note: *Ave= Average

In LMK Resources the results showed a majority of the problems related to ‘individual differences’ and ‘modality’. As shown in Table 9 the results indicate that the degree of customization is not provided in the dialogue elements. The other usability problem refers to the lack of having irreversible commands and escape routes for the user if he wishes to opt out of the system during the process.

Table 9. Results for Usability Testing at LMK Resources

Usability Guidelines	P 1	P 2	P 3	P 4	P 5	Ave*
Individual Differences	33%	50%	75%	33%	100 %	58%
Modality	100 %	67%	100 %	0%	0%	53%
Feedback	0%	67%	67%	33%	0%	33%
Human Memory Limitation	0%	25%	25%	100 %	0%	30%
System Messages	33%	25%	50%	33%	0%	28%
Simplicity	33%	0%	33%	33%	33%	26%
Cognitive Directness	100 %	0%	0%	0%	0%	20%
Color Scheme	40%	20%	0%	20%	0%	16%
Attention	67%	0%	0%	0%	0%	13%
Consistency	60%	0%	0%	0%	0%	12%
Display Issues	40%	0%	20%	0%	0%	12%
Anthropomorphization	0%	0%	0%	0%	0%	0%

Note: *Ave=Average

The groupware in Askari Commercial Bank has the most usability problems of all, by a having majority of the problems with ‘individual differences’, ‘cognitive directness’, ‘system messages’, ‘feedback’ and ‘display issue’. As shown in the Table 10 ‘individual difference’ was the most problematic issue of the interface. A majority of the user participants preferred to have more user preference for screen layout and appearance of icons. The second highest rated usability problem was the ‘cognitive directness’, which demands the system to use meaningful icons/ letters throughout the system. Lastly the problem that concerned the users was the ambiguous messages that were displayed on several occasions. They often encountered alarming messages that lacked specific and constructive words. The system also lacked appropriate status indicators to show the user the progress with a lengthy operation and appropriate articulatory feedback. The last issue concerned the users regarding the interface was the display issue, which refers to maintaining display inertia. It regards to the changes from one screen to the next within a functional task situation. The users found the screen layout being less balanced with information not grouped logically.

Table 10. Results for Usability Testing at Askari Commercial Bank

Usability Guidelines	P 1	P 2	P 3	P 4	P 5	Ave *
Individual Differences	100 %	100 %	75%	100 %	100%	95%
Cognitive Directness	100 %	0%	100 %	100 %	100%	80%
System Messages	100 %	0%	50%	100 %	100%	70%
Feedback	100 %	50%	50%	67%	67%	66%
Display Issues	40%	75%	40%	40%	60%	51%
Color Scheme	60%	20%	40%	40%	60%	44%
Human Memory Limitation	75%	25%	25%	25%	50%	40%
Modality	33%	50%	33%	33%	33%	36%
Consistency	20%	33%	20%	20%	33%	25%
Simplicity	0%	0%	0%	33%	33%	13%
Attention	0%	0%	0%	0%	33%	7%
Anthropomorphization	0%	0%	0%	0%	0%	0%

Note: *Ave=Average

Table 11 shows the highlighted percentage of usability problems of interface found within each participating organization. The interface of Askari Bank's in-house groupware shows the highest percentage of usability problems, whereas LMK Resources shows the least percentage of usability problems. Among the highly rated usability problems, 'individual difference' was found to be the highest problematic element of the interface in all the three-groupware products. The users were not satisfied with the degree of customization of screen layout and icons according to their individual preference. 'Anthromorphization' was least rated among other usability problems discovered in the interface of all the three groupware products. This aspect relates to the attribution of human characteristics to objects. Consistency of the icons, terminologies and color scheme was another issue, which was not evaluated by the users as a major usability problem. 'Consistency' had been maintained in the interface of SIMEX and Lotus Notes.

Table 11. Comparison of the results of UT among Enterprise Technologies Pvt. Ltd., LMK Resources and Askari Commercial Bank

UT GUIDELINES	ETPL	LMKR	ACB
Consistency	4%	12%	25%
Simplicity	20%	26%	13%
Human Memory Limitation	25%	30%	40%
Cognitive Directness	80%	20%	80%
Feedback	40%	33%	67%
System message	15%	28%	70%
Anthromorphization	0%	0%	0%
Modality	0%	53%	36%
Attention	67%	13%	7%
Display issue	34%	12%	51%
Individual differences	100%	58%	95%
Color scheme	46%	16%	44%
AVERAGE	36%	25%	44%

4. Comparisons and Discussion

After obtaining the results of HE and UT, a comparison of the usability problems was made within each organization. Table 12 shows the total usability problems found through using HE and UT. The last column shows the average of HE and UT found within each participating organization.

Table 12. Comparison of both techniques

	COMPANIES			
UEM	ETPL	LMKR	ACB	Average
HE	42%	45%	40%	42%
UT	36%	25%	44%	35%

The average percentages of usability problems (UP) identified by HE and UT are 42% and 35% respectively. Combining the results obtained in all the three organizations, HE found a higher percentage of usability problems, exceeding UT by 7%. Overall it can be inferred that HE as applied in this study has produced the best results as it exposed more usability problems than UT and both yielded different types of usability problems. Our intent for using HE was to carry out a broad inspection that would look into every aspect of groupware interface.

Comparing both Usability Evaluation Methods within individual company case shows somewhat different picture for Askari Commercial bank. The percentage of usability problems identified by UT is higher than HE. The evaluators might have overlooked what might seem to be a potential problem from a user's point of view or they overestimated the user's capabilities. In ETPL and LMKR where the HE yields higher percentage of usability problems than UT, this situation can be explained from two perspectives, evaluators' and users'. According to the users that particular aspect of interface may not have looked as a potential weakness to

them, therefore they didn't consider it as a potential threat. As interpreted by Law & Hvannberg (2002), it could be that the UT participants were unable to locate the usability problems in the first place. Another assessment from evaluators' point of view is that HE produced false positives, which are minor bugs that do not negatively impact user performance or the user's perception of product quality.

A combination of inspection based and user based methods was found to be advantageous in detecting the interface bugs. Gutwin et al. (2001) specifically supported the two techniques (UT and HE) working in combination. Jeffries et al. (1991) addressed the effectiveness of four techniques namely: HE, UT, Guidelines and Cognitive Walkthrough for evaluating UI and inferred that HE and UT produced more serious problems than the other techniques. This combination of methods was also adopted in the study carried out by Law and Hvannberg (2002) in the European context, focusing on the two cultures, Swiss and Icelandic. This study is unique in its own way that no detailed research has been done in Asian cultures specifically in Pakistan.

5. Conclusion

The dual evaluation found out that both UEMs have a valid role in groupware evaluation. The two types of techniques worked well in combination uncovering several potential problems, which couldn't be revealed by using only one evaluation method. In this study the need for adopting the dual evaluation method is not only to measure the effectiveness of each technique but also to uncover as many of the usability problems as possible. The evaluations using both techniques showed that not only major problems have been uncovered but the minor ones came to light as well. Even though HE showed false positive in two cases, overall it helped in addressing bugs that impact user performance and satisfaction. To have more effective detection of usability problem, the UI evaluators and practitioners can use the strengths of these two methods carefully.

Though the study focuses on Pakistani organizations, and the results specifically reflect the situations of these organizations, the findings may very well be applicable to organizations in other developing countries in Asia.

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