End User Development: Satisfaction with Tools and Satisfaction with Applications

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ABSTRACT

This study explored the relationship between end user developers' perceptions of their applications and their perceptions of the tools used to create them. Satisfaction with a user developed application was found to be significantly correlated with satisfaction with the tool used to create the application. The role of experience in this relationship was also explored, and possible implications of the findings are discussed.

INTRODUCTION

End users increasingly use development tools such as spreadsheets, database management systems and Web authoring tools to create applications to support organizational processes and decision making. Organizations rely heavily upon these applications (McLean, Kappelman, & Thompson, 1993). Organizations also rely very heavily on end users' perceptions of the fitness of these applications for use, as little formal evaluation of the quality of user developed applications (UDAs) is undertaken (Panko & Halverson, 1996). However, end user developers often have little experience or formal training with the tools they are using (McGill, 2000; Taylor, Moynihan, & Wood-Harper, 1998) raising concerns about their ability to make realistic judgements.

Research into end user development tools has tended to address their acceptance rather than their impact. Of the studies reviewed by Brancheau and Brown (1993), only two addressed tool dependent outcomes: problems with mismatch in the task-tool fit (Pentland, 1989), and the potential longitudinal impact on task resolution (Carlsson, 1988). Brancheau and Brown also noted that 'most studies tend to ignore the specific characteristics of tools employed by end users' (Brancheau & Brown, 1993 p.459).

Innovation diffusion theory suggests that tool characteristics are important determinants of adoption and subsequent end user action (Moore, 1987). The results of a study by McGill (2000) suggest that some end users have difficulty perceiving their applications as separate from the tools used to create them. For example, when asked explicitly about spreadsheets they had created around one third of the subjects responded: that unauthorized users could not easily access their data; that each user owned a unique password for the application; and that their application always issued an error message when it detects an error. Whilst the operating systems and spreadsheet packages used to create these applications either contained this functionality or the means to create it, very few of the applications had these forms of data protection implemented. If end user developers have serious misconceptions such as these, it could pose significant risks to the security and integrity of organizational data and to the quality of organizational decision making.

Attribution theory is concerned with the cognitive processes that people use to explain their performance in situations where causal relations are ambiguous (Weiner, 1986). Hufnagel (1990) used causal attribution theory to investigate the relationship between user satisfaction and performance in a computer-based business game and found that participants who were unsuccessful tended to blame their poor performance on luck and/or the quality of the system. These results suggest that the evaluation of development outcomes could have a causal attribution component. Moreover, since the tool is the key implementation component in the development process, causal attribution may appear all the more justified to a user developer. Thus end user perceptions of development tools may influence perceptions of the application developed, but perceptions of UDAs may also influence perceptions of development tools.

RESEARCH QUESTION

This study was designed to explore the relationship between end users' perceptions of their applications and their perceptions of the tools used to create them. The research question investigated in this study was:

What is the relationship between end user developer satisfaction with applications they have developed and satisfaction with the development tools?

In an early study of end user development, Rivard and Huff (1988) found perceived userfriendliness of development tools to be positively related to overall user satisfaction with the experience of developing applications in their organization. Amoroso and Cheney (1991) proposed a model of end user application effectiveness that included perceived quality of application development tools as a determinant of end user information satisfaction and found a weak positive relationship. Causal attribution theory would suggest that satisfaction with an UDA could influence satisfaction with application development tools. Figure 1 shows the possible relationships between end user developer satisfaction with development tools and satisfaction with UDAs. In this study it was hypothesised that:

H1: Satisfaction with a UDA is positively correlated with satisfaction with the development tool used to create it.

H2: Satisfaction with a UDA is positively correlated with satisfaction with the operating system being used to when development took place.
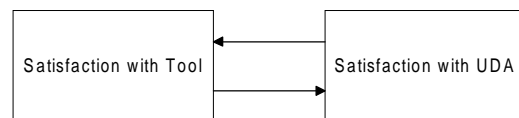

Figure 1: Possible relationships between end user developer satisfaction with development tools and satisfaction with UDAs.

METHOD

Participants

The participants in the study were 122 undergraduate stu-

dents (67 male, 55 female) enrolled in an information systems service course intended primarily for business students. The course was designed to prepare students to participate in end user computing activities in organisations once they graduate and join the workforce, rather than to become information technology professionals. The participants had an average of about 2.5 years of experience (29.88 months) using spreadsheets with a minimum of just a few weeks and a maximum of 10 years (120 months). Participants were recruited during class and completed the questionnaire on the spot. It was stressed that the completion of the questionnaire was voluntary and that it formed no part of their assessment in the course.

The User Developed Applications

Prior to the study, each of the participants had completed a case that required them to design and develop a spreadsheet application to provide decision support to a small business. The case was selected because it represented a realistic problem for an end user to analyse, and the scope and complexities were typical of the type of applications that end users would be likely to tackle in a 'real' work situation. It also involved the application of spreadsheet software, which is the most popular end user tool in organisations (McLean et al., 1993). Applications were required to be developed in Microsoft Excel in the Microsoft Windows environment. The case description was approximately 3 pages long and the finished spreadsheet required at least 2 linked worksheets. It was anticipated that it would take the subjects at least 2 days to plan and develop the application. This application constituted 7.5% of each student's overall course grade.

The Questionnaire

User satisfaction refers to the attitude or response of an end user towards information, an information system or a development tool. User satisfaction with an application has been defined as 'the affective attitude towards a particular computer application by an end user who interacts with the application directly' (Doll & Torkzadeh, 1988). User satisfaction with the UDA was measured using 10 items from the 12 item end user computing satisfaction (EUCS) scale developed by Doll and Torkzadeh (1988) (see Appendix 1). This instrument was chosen as it has been commonly used in the end user computing domain (e.g. Gelderman, 1998; Igbaria, 1990; Rahman & Abdul-Gader, 1993). Two items were not included because they were not appropriate to the case study situation and minor adaptations to wording were also made to reflect the terminology used in the case and the environment in which application development and use occurred. Each item was measured on a 5 point Likert-type scale ranging from (1) 'almost never' to (5) 'almost always'. The instrument was shown to be reliable with a Cronbach's alpha of 0.92. The scores for each item were totalled to produce an overall satisfaction with the UDA score.

User satisfaction with a development tool refers to the end user's affective attitude to its suitability for use. In this study it was measured using a 4 item 7 point semantic differential scale (see Appendix 1). Seddon and Yip's (1992) 4 item user satisfaction instrument was used as the starting point for the item development as it attempts to measure user satisfaction directly rather than confounding it with information quality and system quality. The instrument had a Cronbach's alpha of 0.69, which can be considered marginally acceptable for exploratory research (Hair, Anderson, Tatham, & Black, 1998). The

scores for each item were totalled to produce an overall satisfaction with Microsoft Excel score.

The questionnaire also included a one item measure of satisfaction with the Microsoft Windows environment in which development had occurred (see Appendix 1).

RESULTS AND DISCUSSION

Table 1 summarizes the satisfaction of the participants with the application they developed, with Microsoft Excel as a tool for end user development and with Microsoft Windows as an operating environment. The average level of satisfaction with Microsoft Windows was 3.84 (out of 5, 77%), the average level of satisfaction with Microsoft Excel was 19.55 (out of 28, 69.8%) and the average level of satisfaction with the UDAs was 39.26 (out of 50, 78.5%). The levels of satisfaction with both Microsoft Windows and The UDAs were relatively similar but the satisfaction with Microsoft Excel was slightly lower.

Table 1: Summary of the satisfaction of the participants with the UDA they developed, with Microsoft Excel as a tool for end user development and with Microsoft Windows as an operating environment.

	N	Mean	Minimum	Maximum	Std. Deviation
Months of Experience	116	29.88	0	120	28.15
Satisfaction with Microsoft Windows	122	3.84	0	5	1.03
Satisfaction with Microsoft Excel	122	19.55	4	28	4.33
Satisfaction with the UDA	118	39.26	3	50	7.54

The research question investigated in this study considered the relationship between end user developer satisfaction with development tools and satisfaction with the resulting application. To address this question, the Pearson correlation coefficients were calculated between Satisfaction with Microsoft Windows, Satisfaction with Microsoft Excel and Satisfaction with the UDA (see Table 2). There was a significant positive correlation between Satisfaction with the UDA and Satisfaction with Microsoft Excel (r=0.479, p=0.000). Thus the results support the first hypothesis. Those end users who are satisfied with a UDA are also satisfied with the development tool used to create it. This result is consistent with the findings of Rivard and Huff (1988) and Amoroso and Cheney (1991). The results however do not provide evidence as to the direction of the relationship. Satisfaction with the development tool may result in satisfaction with the UDA. But it is also possible that lack of satisfaction with a UDA may cause lack of satisfaction with the development tool as predicted by attribution theory. Future research should further investigate the nature of this relationship.

Table 2: Correlations between satisfaction with Microsoft Windows, Microsoft Excel and the UDA

	Correlations		
	Satisfaction with UDA	Satisfaction with Microsoft Excel	Satisfaction with Microsoft Windows
Satisfaction with the UDA	1.000	0.479 (p=0.000)	0.072 (p=0.439)
Satisfaction with Microsoft Excel	0.479 (p=0.000)	1.000	0.494 (p=0.000)
Satisfaction with Microsoft Windows	0.072 (p=0.439)	0.494 (p=0.000)	1.000

No significant relationship was found between Satisfaction with the UDA and Satisfaction with Microsoft Windows (r=0.072,

p=0.439). Therefore the second hypothesis was not supported. Whilst an operating system is an essential tool for system development and use, end user developers are not required to interact with it directly while developing applications. It thus appears that they are able to clearly differentiate between them, and the two types of satisfaction are not confounded.

The relationship between User Satisfaction with Excel and User Satisfaction with the Windows environment was not specifically covered by the hypotheses in the study. However, it is interesting to note that there was a significant positive correlation between Satisfaction with Microsoft Excel and Satisfaction with Microsoft Windows (r=0.439, p=0.000). This is not surprising as both are developed by same company and share similarities in user interface. End users' perceptions of Microsoft and its products are likely to be consistent. Of the 122 participants, 62 (50.8%) had used another operating system but only 36 (29.5%) had used another spreadsheet package. The relatively limited range of experience with different spreadsheet packages in this sample is indicative of the broader end user population and raises questions about the role of variety in end user learning. If end users are only exposed to only one product their ability to recognise quality in software development tools may be limited.

The role of experience in the hypothesised relationships was also explored in post hoc analyses. Partial correlation coefficients were calculated to determine the relationship between Months of Experience and Satisfaction with the UDA when Satisfaction with Excel was controlled for (r=0.1026, p=0.284) and between Months of Experience and Satisfaction with Excel when Satisfaction with the UDA was controlled for (r=0.2066, p=0.030). The lack of a significant relationship between experience and satisfaction with the UDA is not unexpected. Whilst intuitively increased experience should lead to increased skill and hence higher quality applications with which the developers are more satisfied, the findings in the literature have been mixed. Crawford (1986) and Amoroso and Cheney (1991) found a positive relationship between experience and satisfaction, however some authors have either found experience to be negatively correlated with satisfaction with the UDA (Janvrin & Morrison, 2000) or found no relationship (Al-Shawaf, 1993). Yaverbaum and Nosek (1992) speculated that computer training increases one's expectations of information systems, and hence may actually cause negative perceptions. This may also be the case for experience in the UDA domain.

The positive relationship between experience and satisfaction with Excel is not surprising. Microsoft Excel is a powerful development tool and users could be expected to require a substantial investment in time to become comfortable with it, hence satisfaction wold increase over time.

The relationship between the two types of satisfaction was found to be still significant when experience was controlled for (r=0.3903, p=0.000). This finding raises some concerns because if the results of this study do signal a confounding between perceptions of development tools and perceptions of UDAs, it would be hoped that this confounding would decrease with experience. It may be that when end user developers have low experience, they develop applications of lower quality and are less satisfied with them. This could feedback into their satisfaction with the development tool via causal attribution. However, when end users have more experience, they might be expected to be both more satisfied with Excel because of the time they have spent using it, and also be developing applications of better quality, that they can be more satisfied with. Hence two different mechanisms may be operating here.

CONCLUSION

The results of this study provide some support for the view that end user developers may not clearly differentiate between the applications they develop and they tools used in the development process. This lack of clear differentiation may be a confounding factor in evaluating outcomes of user development of applications. However, this study is only very exploratory, using student subjects who may not be representative of the wider end user developer population. Future research is also needed to further elucidate the relationship between satisfaction with development tools and satisfaction with UDAs. An understanding of the directions of the relationship and mechanisms by which it operates will provide valuable insights into end user development and the processes by which end users evaluate their own applications.

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APPENDIX 1
Items Used in the Questionnaire
Satisfaction with the UDA

Is the spreadsheet accurate?
most never   almost always
1   2   3   4   5

Does the spreadsheet provide the precise information you need?
1   2   3   4   5

Is the spreadsheet user friendly?
1   2   3   4   5

Is the information given on the spreadsheet clear?
1   2   3   4   5

Does the spreadsheet seem to be just exactly what you need?
1   2   3   4   5

Do you think information is presented in a useful format?
1   2   3   4   5

Is the spreadsheet easy to use?
1   2   3   4   5

Can the information you need be accessed reasonable quickly?
1   2   3   4   5

Does the spreadsheet provide sufficient information?
1   2   3   4   5

Are you satisfied with the accuracy of the information?
1   2   3   4   5

Satisfaction with Microsoft Excel

How adequately does Excel meet your spreadsheet needs?
1 2 3 4 5 6 7
adequately   inadequately

How difficult to use is Excel for spreadsheet development?
1 2 3 4 5 6 7
difficult   simple

How supportive is Excel during spreadsheet development?
1 2 3 4 5 6 7
excellent   poor

Overall, how satisfied / dissatisfied are you with Excel?
1 2 3 4 5 6 7
dissatisfied   satisfied

Satisfaction with Microsoft Windows

Overall, are you satisfied with Microsoft Windows?
1 2 3 4 5
dissatisfied   neutral   satisfied

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