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An official publication of the Computer Society of South Africa and of the South African Institute of Computer Scientists

'n Amptelike tydskrif van die Rekenaarvereniging van Suid-Afrika en van die Suid-Afrikaanse Instituut van Rekenaarwetenskaplikes

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'n Amptelike tydskrif van die Rekenaarvereniging van Suid-Afrika
en van die Suid-Afrikaanse Instituut van Rekenaarwetenskaplikes

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NOVICE ATTITUDE CHANGES DURING A FIRST COURSE IN COMPUTING: A CASE STUDY

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SUMMARY

This paper describes a study of changes in attitude toward computers exhibited by novice student users during a first course in business computing. Several dimensions of attitude were established by factor analysis. Student attitudes were assessed on starting the course, shortly after their first experience with "hands-on" computing and on course completion. Important components of attitude changed negatively on initial contact with computer systems, even with a "user-friendly" decision support system. Further course work, including exposure to conventional programming languages, induced more negative changes.

1. INTRODUCTION

Attitude towards computers has been shown to play a significant role in the successful implementation and use of computer systems (see, e.g. [2, 11, 12, 15, 18, 21]). The measurement of success is itself an area of some interest, with measures based on actual usage, user satisfaction and user performance being considered [1, 7, 15]. The bulk of the research supports the view that attitude plays a significant role in voluntary computer use [2, 11, 12, 15, 21] but that situational factors may act to negate this effect [8, 16].

A variety of techniques have been used in measuring attitude towards computers, with the most common being the use of five or seven point Likert scales [2, 11, 16, 18, 20]. The semantic differential technique has also proved fairly popular [1, 14, 19]. Lucas [12] has suggested that work is required to determine the role of different components of attitude and the present study utilises a multidimensional view of attitude, firstly establishing components of attitude by factor analysis before observing changes in these factors in both the short and longer term.

Rather less research has been done directly on the question of attitude change. Vasarhelyi [19] found that users can be positively influenced toward the use of man-machine systems by exposure to systems with convenient interactional features and that attitudes towards creativity in the use of computers will be changed by practical utilisation. Young [20], in studying the effect of an MIS course on MBA student attitudes, found that course content widened student perceptions of computers for improving organisational flexibility, management effectiveness and problem-solving capability but noted a side-effect of the influence of the teacher's own attitudes in forming student attitudes.

Most universities and other institutes of higher education provide at least one course covering aspects of business computing for students intending to follow a career in commerce. For many students this is their first direct contact with computer systems and can play an important part in the formulation of attitudes towards computers. The objectives of this study were (a) to identify the dimensions of attitude toward computers and (b) to examine possible changes in attitude on these dimensions as a function of exposure to a first course in business computing in a university environment.

2. METHOD

2.1 The Attitude Survey Instrument

The attitude assessment instrument used [Table 1] was that developed by Lee [10] to measure the general public's attitude to computers. The questionnaire is based on twenty attitudinal statements, each of which requires the respondent to rate his/her degree of agreement/disagreement with the statement on a seven-point Likert scale. The instrument was intended to measure two dimensions of attitude (established by factor analysis). These dimensions are (a) the extent to which the computer is viewed as a tool to benefit man and (b) the extent to which the computer is seen as an independent thinking machine. Lee labelled these as a

“beneficial tool of man” factor and an “awesome thinking machine” factor. The attitudinal statements were slightly modified for local terminology and conditions. In particular, statement five (originally “They are very important to our man-in-space program”) would have had little meaning in a country with no such space program and was replaced by “They are very important to the general economic development of our country”.

2.2 Procedures

The attitude questionnaire was administered in two stages. A sample of 378 undergraduate business administration students was utilised to identify the dimensions of the attitudes towards computers. A second sample of 142 students was used to study attitude change as a function of a course on business computer use. The attitude of these students was assessed in the first lecture of the computing course being attended, immediately following completion of the first financial modelling case study some four weeks later and on completion of the course some eight months after the initial survey. 142 students completed the first questionnaire, 94 the second and 120 the third. Those subjects with prior experience (17) were removed from the sample. In assessing the changes over time, certain subjects were rejected for failing to complete one of the questionnaires. The analysis was performed for short-term changes (between the first and second questionnaires) ($n=92$), changes over the rest of the course (between the second and third questionnaires) ($n = 84$) and overall changes (between the first and third questionnaires) ($n = 100$).

2.3 The Computer Course

The business data processing course taught to the students provided a general introduction to commercial computing which included an overview of hardware and software, programming in COBOL, basic systems analysis, the use of packages and general controls in a business computing environment. The practical work began with a case study requiring the development of a financial model (with a DSS package similar to a subset of IFPS [3]) and was followed by several COBOL programs spread throughout the course. The course was taught by several lecturers and students had interactive terminal access to a central facility for practical work.

3. RESULTS

3.1 Dimensions of Attitude Toward Computers

The data gathered in the initial survey was factor analysed using the SPSS FACTOR routine with varimax rotation and six factors were identified with eigenvalues greater than one. However, both the six and five factor solutions include factors which load significantly on only one variable and are insufficiently defined. The four factor solution provides the most viable set of factors and has a fairly close correlation with the results obtained by Morrison [13]. Factor distinguishability is adequate with the highest correlation between factors 1 and 4 ($r = 0,29$). A two factor solution was also generated to allow comparison with Lee's original results [10].

Two tests for factor similarity were applied in comparison with previous results: Pearson's r and Cattell's salient similarity test. Cattell's salient similarity index s may be used to compare correlation patterns and provides a level of statistical significance for the match. In calculating the index for this study, loadings in excess of 0,30 were considered positively salient for the factor, loadings less than -0,30 negatively salient with the remaining values being in the hyperplane (i.e. not loading significantly on this factor). Unfortunately, the tables available for the similarity index only include hyperplane counts of 60% and above. For lower hyperplane percentages, the significance of s cannot be established from these tables.

The Pearson product-moment correlation coefficient r provides a measure of both pattern and magnitude of loadings. However, the use of this coefficient should be treated with caution as it is possible, given a large number of variables, to obtain sizable correlations because of the many variables with small loadings that are not used to define either factor.

The comparison with Lee's two factors (Table 1) shows a strong similarity between the factors (Factor 1: $r = 0,95$, $s = 0,80$ with 45% hyperplane count; Factor 2, $r = 0,90$, $s = 0,88$ with 45% in the hyperplane) providing support for the two underlying dimensions of attitude

established in this study. However, the two factor solution has a high proportion of unexplained variance (only 30,3% explained) whereas the four factor solution explains 13,3%. It was felt that the additional factors could provide more insight into the attitude towards computers construct. In addition, a good correlation exists between Lee's first factor and the first of the four factor solution ($r = 0,85$, $s = 0,75$, with 50% in the hyperplane). Little is lost in the first factor by choosing a four factor structure but there could be some gains in interpretation sensitivity by including the additional factors.

Statement	Factor 1		Factor 2	
	Lee	sample	Lee	sample
1. There's something exciting & fascinating about machines with electronic brains	.30	.50	.28	-.16
2. Computers are rather strange and frightening	-.15	-.30	.44	.36
3. They do such amazing things that they stagger your imagination	.13	.18	.42	.42
4. They make you feel that machines can be smarter than people	.13	-.04	.57	.51
5. They are very important to the general economic development of our country	.56	.58	-.03	.04
6. They can be used for evil purposes if they fall into the wrong hands	.10	.05	.25	.33
7. They will bring about a better way of life for the average man	.53	.56	-.03	-.07
8. With these machines the individual will not count for very much any more	-.09	-.34	.60	.47
9. They can think like a human being thinks	.10	-.04	.62	.32
10. These machines will free people to do more imaginative & interesting types of work	.40	.48	-.04	-.12
11. They are becoming necessary to the efficient operation of large business companies	.55	.52	.10	-.05
12. They can make serious mistakes because they fail to take the human factor into account	-.13	-.25	.17	.24
13. Some day in the future these machines may be running our lives for us	.02	.11	.56	.54
14. They make it possible to speed up scientific progress and achievements	.59	.45	.02	.02
15. There is no limit to what these machines can do	.17	.24	.50	.29
16. They work at lightning speed	.49	.27	.21	.16
17. These machines help to create unemployment	-.12	-.43	.39	.41
18. They are extremely accurate and exact	.52	.41	-.04	-.04
19. These machines can make important decisions better than people	.21	-.08	.46	.31
20. They are going too far with these machines	-.33	-.59	.50	.29

table 1

Comparison of Lee's Results with Sample-Factor Loadings

Morrison performed a survey amongst 412 Australian students using Lee's survey instrument and extracted a four factor solution. His results are compared with those of the present survey in Table 2. The first three factors correlate fairly well with Morrison's results, although the order of extraction differs. There is no relationship for the fourth factor. The Australian sample included a majority of "external" students somewhat older than the student norm. When the present study was extended by the addition of 191 attitude surveys of individuals in business, the four factors extracted matched all those of the Australian study [4].

The order of extraction of factors is related to the strength of disagreement between respondents, i.e., the greatest variance and highest covariance. The first factor extracted in this study is a positive one corresponding to Lee's "beneficial tool of man" perspective while the first three factors extracted in the Australian study were essentially negative. The positional change of these factors, particularly the first sample factor to the fourth Australian factor, indicates that the present sample showed greatest variance on the positive aspects of computing while the Australian sample showed greatest variance on the negative.

The first factor to emerge (16,9% of variance) is undoubtedly a positive view of computers closely analogous to Lee's "beneficial tool of man". It loads high on variables dealing with the excitement of new technology ("exciting and fascinating", "bring about a better way of life", "speed up scientific progress") and with their value to commerce ("general economic development", "efficient operation of companies").

Factor 2 (13,4% of variance) is concerned with certain negative aspects of computerisation. It deals essentially with variables relating to possible negative effects on society and individuals ("help to create unemployment", "individual will not count for much anymore") as well as a fear of the power of computers over people ("running our lives for us", "make important decisions better than people", "smarter than people"). Morrison characterised this as simply a negative factor. However it appears to reflect more specifically a fear of computer power and the role of computers in society.

variable	S factor 1	M factor 4	S factor 2	M factor 1	S factor 3	M factor 3	S factor 4	M factor 2
1	.53	.07	-.08	-.13	.23	.57	.03	.15
2	-.23	.05	.13	.24	.54	.48	-.06	.03
3	.22	.22	.21	.02	.48	.62	.18	.16
4	.01	.05	.44	.32	.32	.45	.05	.50
5	.53	.60	-.02	-.21	-.02	.12	.23	-.13
6	.10	.74	.18	.26	.22	.17	.09	.00
7	.49	.56	-.09	-.37	-.01	.08	.24	.19
8	-.22	.03	.67	.74	-.01	-.03	-.13	.14
9	-.01	-.16	.28	.01	.06	.20	-.20	.53
10	.28	.06	-.15	-.13	-.02	-.13	.44	.11
11	.55	.33	-.02	-.12	-.13	.16	.07	.01
12	-.14	.03	.09	.42	.28	.23	-.08	-.16
13	-.05	.02	.56	.57	.20	.01	-.06	.35
14	.46	.35	-.05	.04	-.02	.09	.05	-.16
15	.16	.01	.28	.16	.13	.01	.18	.57
16	.01	.08	.12	.26	.12	.38	.60	.02
17	.33	-.11	.43	.57	.15	.23	.04	-.16
18	.19	.01	.09	.00	-.18	.25	.51	.06
19	.10	.07	.41	-.09	.03	.06	.13	.65
20	.64	-.11	.17	.33	.35	.18	.02	.07
Eigenvalues	3.37	1.56	2.68	3.22	1.32	1.96	1.30	3.08
% Variance	16.9	7.8	13.4	16.1	6.6	9.8	6.5	15.4
	r = 0.62		r = 0.76		r = 0.64		r = -0.06	
	s = 0.67		s = 0.67		s = 0.67		s = 0	
	P < 0.001		P < 0.001		P < 0.001		not signif.	

S : Student Sample M: Australian Results.

table 2

Four Factor Solution with Morrison's Results

Factor 3 (6,6% of variance) has certain aspects of the "awe and wonder" of Lee's second dimension. It loads high on variables 2 ("strange and frightening") and 3 ("stagger your imagination") with some loading on variables 4 ("machines can be smarter than people") and 20 ("going too far with these machines"). Morrison termed this factor a "naive" concern, stating "... seems to express an inadequate understanding of computers to the point of astonishment".

Factor 4 (6,5% of variance) again deals with more positive aspects of computers. It loads significantly on variables 10 ("free people for more imaginative work"), 18 ("work at lightning speed") and 18 ("extremely accurate and exact"). It appears to reflect a "technical appreciation" dimension of attitude.

3.2 Attitude Changes after Exposure to the Course

A matched pairs approach was used for data analysis. For each case, the change in attitude (positive or negative) on the Likert scale was determined for each variable, i.e. a student changing from 7 (strongly agree) to 3 (mildly disagree) would have a change of -4 in this variable.

Changes in the factors of attitude were determined by multiplying the individual differences by the relevant weights of the significant factor loadings. To assess significance of any change, a t-test was used to determine whether the sample mean was significantly different from zero with the t-value computed as

$$t_{N-1} = (X/S) \sqrt{N} \quad (N = \text{sample size})$$

The results of the analysis are summarised in Table 3. In interpreting these results, it should be noted that a positive change implies a stronger tendency to agree with the set of statements comprising a factor while a negative change implies a tendency to disagree. A positive change in factors 1 and 4 thus suggests an improved attitude on the positive aspects of computing while the reverse would hold for the negative factors, i.e. 2 and 3.

The most important short-term and long-term change observed is a sharp decline in the positive appreciation of computers and their value (Factor 1). Subjects experienced this change rapidly, i.e. during the first case study (their first hands-on experience) with little change during the rest of the course. Apparently the image of the computer as a "beneficial tool of man" suffers considerably when novices are faced with the realities of computer use, even when working with supposedly user-friendly packages such as financial modelling systems.

The second factor shows a positive improvement in the short term, i.e. subjects generally had less "fear of the computer" and a less negative view of computers. However, this change was reversed during the rest of the course with a significant swing back towards negative attitudes. It could be that the ease of use of a simple DSS can reduce certain negative aspects of attitude towards computers but that these return when subjects are faced with 'conventional' languages such as COBOL. The other factor dealing with negative components of attitude (Factor 3) did show a strong reduction of negative views in both the short and long term. Novice subjects had less "fear and awe" or "naive concern" shortly after first using the system and retained this view thereafter.

The fourth factor, characterised as a technical appreciation dimension, again showed a short term improvement with little change over the rest of the time period. Subjects generally became more impressed with the physical capabilities of computers.

	Short. Term \bar{X}	n = 92 (1st/2nd Survey) t	Rest of Course \bar{X}	n = 84 (2nd/3rd Survey) t	Long Term \bar{X}	n = 100 (1st/3rd Survey) t
Factor 1	-0.39	4.48**	-0.05	0.61	-0.42	4.57**
Factor 2	-0.21	2.02*	0.29	2.91**	0.09	0.94
Factor 3	-0.48	4.91***	-0.03	0.31	-0.36	3.20**
Factor 4	0.24	2.58*	-0.02	0.25	0.20	2.51*

* p < 0.05

** p < 0.01

table 3

Attitude Changes over Time

3.3 Sex Differences in Attitude Change

Despite some decades of attempts to reduce sex role stereotyping, differences still exist between males and females with regard to career paths and roles in society. It is of interest to determine whether these differences also exist in terms of an individual's perception of the value of computers within a group intending to enter the same general career area. Analysis of variance was used to determine whether any significant differences in attitude were present between males and females in each survey (Table 4). Attitude changes within each group were also analysed (Table 5).

	Survey 1		Survey 2		Survey 3	
	F	P	F	P	F	P
Factor 1	4.09	0.04*	0.78	0.37	0.19	0.66
Factor 2	5.06	0.03*	5.82	0.02*	1.04	0.31
Factor 3	1.38	0.24	1.69	0.19	0.02	0.88
Factor 4	0.10	0.92	0.03	0.85	1.32	0.25

*p < 0.05

table 4

Sex Differences in Attitude

Prior to computer exposure, female students had a less positive view of computers (Factor 1) and a higher score on negative aspects or fear of computer power (Factor 2). Factor 2 remains significantly different in the short term but the differences on the positive aspects of computers disappear fairly rapidly. By the end of the course there were no significant differences for any

factor between males and females. From Table 5 it can be observed that the reduction in these differences is primarily due to strong changes in attitude within the male group. Male subjects showed a greater negative change on the first factor on first contact with computers and a strong increase on the negative views of computing between the second and third surveys. The male subjects evidently had higher expectations of the value of computers which were nullified by hands-on experience.

	Short Term (1st/2nd Survey) n = 27		Rest of Course (2nd/3rd Survey) n = 22		Long Term (1st/3rd Survey) n = 26	
females	\bar{X}	t	\bar{X}	t	\bar{X}	t
Factor 1	-.23	1.55	-.09	0.62	-.31	2.17*
Factor 2	-.14	0.84	+.12	0.69	-.08	0.15
Factor 3	-.57	3.11**	+.13	0.65	-.46	2.01*
Factor 4	+.28	1.65	-.13	0.75	+.08	0.45

	Short Term (1st/2nd Survey) n = 65		Rest of Course (2nd/3rd Survey) n = 62		Long Term (1st/3rd Survey) n = 74	
males	\bar{X}	t	\bar{X}	t	\bar{X}	t
Factor 1	-.52	4.47**	-.05	0.44	-.46	4.03**
Factor 2	-.21	1.37	+.43	3.53**	+.13	1.18
Factor 3	-.40	3.16**	-.01	0.03	-.33	2.39*
Factor 4	+.23	2.00*	+.08	0.81	+.24	2.86**

* : $p < 0.05$

** : $p < 0.01$

table 5

Attitude Change in Males and Females

CONCLUSIONS

As noted in the introduction, attitude can play a significant part in the successful implementation and use of computer systems. Kerlinger [9:495] defines attitude as "...an enduring structure of beliefs that predisposes the individual to behave selectively towards attitude referents" and it is probable that attitudes formed by first contact with computers within an educational setting could well influence later acceptance and use of computers in business.

This study identified four components in the attitude towards computers construct, the structure of which agrees with earlier work. Although the dimensions extracted in a factor analysis are dependent on the items available in the survey instrument, it is apparent that attitude towards computers consists of both negative and positive aspects. For this reason, a simple pro-con attitude scale is unlikely to provide sufficient insight for studies of the role of attitudes in computer use.

The lack of a control group in the study of attitude change makes it impossible to confirm causal relationships and these findings should be considered as possible indicators within the context of a case study. Although a control group would have been eminently desirable, finding a suitable group of similar students and providing the course input without hands-on computer use is not feasible within the undergraduate commerce course structure. Discussions with the students involved suggest that actual computer use is a major factor in attitude change, but there is no empirical evidence to directly support this. The strong negative changes in attitude observed in this student sample are perturbing from an educational viewpoint. It would appear possible that hands-on use of computers, even with the more user-friendly systems, could have significant negative influence on an individual's perception of the value of computers. If such direct contact is required, it might be necessary to consider new approaches to cushion the computer shock experienced by novices or, at least, provide as gentle an introduction as possible. The reversal of changes in the negative dimension (Factor 2) suggests that the teaching of conventional programming languages such as COBOL might be counter-productive. Most aspects of commerce do not require such programming ability and, unless students intend to follow careers in computing, it could be that introductory computer courses for business students

should concentrate the practical aspects of such courses on the use of user-friendly packages.

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Only original papers will be accepted, and copyright in published papers will be vested in the publisher.

Letters

A section of "Letters to the Editor" (each limited to about 500 words) will provide a forum for discussion of recent problems.

