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Cultivating the information systems discipline

Niek du Plooy, Sub-Editor: Information Systems

Whether by 'information system' we mean a simple bookkeeping system for a small business, or a monolithic integrated 'management information system' for a global corporation, all organisations currently need information systems in order to function effectively. The computer and business community at large have readily adopted and accepted the use of the term 'information systems', but perhaps without too much real thought being given to any more profound meaning of the term. Departments bearing that name (or something very similar) are commonly found in organisations. But can the same be said for the 'academic' use of the term, as in describing the information systems discipline? Has it been 'accepted' as a separate scientific discipline?

The term 'discipline' is often loosely applied to indicate the scientific 'field', that is, the organised 'body of knowledge' or 'domains of discourse' within which (mainly) academic activities concerning a specific topic or a number of related topics, are conducted. [3] point out that a scientific discipline has a certain paradigm associated with it, meaning that researchers in that discipline are familiar with the research topics, the research methods and the accepted ways to interpret the results in their chosen field. A discipline is further strengthened and consolidated by the educational process whereby a researcher becomes a practitioner in that discipline, initially through the pursuit of academic degrees and thereafter, through recognition amongst his/her peers. Formal study in a particular discipline results in the value sets and exemplars (the 'paradigm') of that discipline being adopted by the student, either consciously or unconsciously.

Is 'information systems' truly a recognised scientific discipline such such as this? In the past, prominent authors such as Peter Keen did not think so [15, 16]. He deplored the lack of a cumulative tradition and advocated that one be built up, asking for a clarification of the reference disciplines of this new science and a definition of its dependent variable and the building of a cumulative tradition, amongst other things. [1] however, disputed Keen's position and pointed to strong links between research and practice found in their analysis. [11] showed clearly that 'orthodoxy' exists in many aspects of information systems, i.e. in information systems methodologies as well as in other areas of information systems development. This claim was supported by [13] who, in a detailed study based on papers in scientific journals, scientific conferences and textbooks, identified seven different but complementary 'schools of thought' within the field of information systems. In a study of leading universities and leading researchers in decision support systems, [9] provide exemplars, at least for that particular sub-discipline. [5] conclude from a citation study of journal influence during the period 1981 through 1985, that the discipline of information systems has attained stability and that it is in no danger of dying. It seems therefore, that Keen's despair is unfounded and that information systems have indeed grown into a separate, identifiable discipline, even if the field is best described as a 'fragmented adhocracy' ([3]).

The existence of an established scientific community in information systems has been given formal recognition by the recent formation of the Association for Information Systems, a professional society in the tradition of scientific societies, with 1400 members in 35 countries. A recently compiled directory of information systems academics contains entries on some 4,500 researchers from more than 1,000 institutions. A number of basic University and other curricula for information systems education have been published over the years [2, 6, 18]. The most recent of these is Curriculum '95, a joint effort by the ACM, AIS, DPMA, IAIM and ICIS [10, 7]. The most popular discussion group on the Internet (ISWorldNet) devoted exclusively to information systems matters has a membership which in 1997 approached 1829 from 53 countries [14]. A well-defined scientific community therefore exists.

In addition, if the existence of sound academic scholarship is further testimony to the existence of a 'discipline', then information systems can proudly point towards a dramatic growth over the past three decades in the number of scientific journals reporting on research in this area [12]. An even more recent study on research outlets showed that, amongst twenty-seven established journals carrying articles in this field, at least three of the most highly rated top ten are devoted exclusively to the discipline.

Yet, can it be said that the information systems discipline has been conclusively defined and that the research problems and research methodologies prescribed for it have been accepted by all who consider themselves to be working in this field? A re-examination and extension of an earlier (1988) list of keywords for use in classifying information systems literature [4] includes a list of the reference disciplines of information systems, as well as lists of the external environment, the technology, the organisational environment, etc., of information systems. We could argue that this very comprehensive list of keywords (nearly 1300) and other classifications define and describe the discipline of information systems accurately and usefully. For instance, the reference disciplines were listed as:

behavioural science, computer science, decision theory, information theory, organisation theory, management theory, language theories, systems theory, research, social science, management science, artificial intelligence, economic theory, ergonomics, political science, psychology. This list reflects the interdisciplinary or pluralistic nature of information systems.

In the same vein, [19] did a study on the themes of submissions to the journal Information Systems Research and produced a list of keywords, concepts and associations that characterise the categories into which they grouped the research questions of articles submitted. This list demonstrates conclusively that the subareas of the discipline (organisational, behavioural and managerial issues) are well established and attract a large number of researchers on a long-term basis. Swanson & Ramiller conclude by observing that the discipline still exhibits the 'fragmented adhocracy' identified by Banville & Landry, and is still topically diverse and '...based on appeals to significantly different and partly incommensurate reference disciplines'.

Thus, fragmentation can have adverse effects – something that information systems researchers should be aware of. However, fragmentation of the discipline of information systems may be evident in the field for a very long time. As has been pointed out [17, 8], the discipline as a whole follows trends in information technology, and researchers tend to build their interests around new technology (e.g. the earlier interest in expert systems and decision support systems, and current interest in computer-supported co-operative work). As information technology evolves, so the research interests will follow these new directions. Although we may wish it were different, it remains a fact that information technology is still a major reference discipline of information systems, and will remain so as long as researchers struggle to separate the fundamental or common issues in different fields from the technological ones.

Clearly, then, information systems is internationally well-established as a flourishing discipline. In the Southern African context it is important that the discipline should not merely flourish but be seen to flourish. To this end, this editorial calls on academics and especially on practitioners to add your contributions, via a submission to SACJ.

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Changes in Entry-Level University Students' Attitudes to Computers from 1985 to 1997

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Abstract

A modified version of Lee's instrument for measuring attitudes to computers was administered to two groups of first-year university students separated by a period of twelve years. Factor analysis was applied to these two samples independently to isolate the key dimensions of attitudes. A comparison of the two sets of results highlights both the changes in attitude structure and the extent to which attitudes within those dimensions have changed. The analysis shows that the structure of computer attitudes has remained stable, but that attitudes within that structure have shifted. Students now hold a far more negative view of the role of computers in society, and more "fear and awe" of computers, but an increased appreciation of the technical power of computers. The researchers also compared the attitudes of students based on their prior experience of computers, their gender and their first language. Some suggestions are proposed to account for these results, taking into consideration the changes in the South African social and educational context.

Keywords: *Attitudes towards computers, Education, South Africa*
Computing Review Categories: *K.3.0, K.4.2*

1 Introduction

The successful implementation of a computing system depends not simply on the quality of the technology, but also on the acceptance of that technology by its users. For this reason, the attitudes of people towards computers is an important topic of investigation. Positive attitudes are likely to result in decreased levels of stress and higher levels of productivity. But how are such attitudes to be measured and how (if at all) can they be altered? Furthermore, as the ubiquity of computational technology increases in our society, do attitudes to computers become more positive or more negative?

During 1984 and 1985 several surveys of student attitudes about computers were performed at the University of Natal [3]. These studies focused on identifying the major components of attitude as well as determining the effect of computing courses and exposure to computer use on attitude change. This study found that, following an introductory computer course, attitude in novice computer users undergoes sharp and, for that sample, basically negative changes in attitude about computers as "a beneficial tool of man" but the students did show less "fear and awe" of the computer.

The researchers were interested in whether student attitude towards computers has changed in any way in the last decade, both in terms of attitude structure and in terms of the way students feel about computers and accordingly, a similar group of novice student computer users was sampled at the University of Natal in 1997. Both surveys were based on a slightly modified form of attitude assessment instrument developed by Lee to measure the general public's attitude to computers [7]. A comparison of the 1997 sample to the 1985 sample showed that while attitude structure remained essentially the same, there were some significant changes in different aspects of attitude as well as some aspects for which the lack of change was surprising[1].

2 Prior Research

It is difficult to isolate a complete and disjoint set of dimensions of attitudes towards computers, although numerous instruments have been proposed. Lee employed a twenty-item questionnaire in 1970 with the intention of measuring two dimensions of attitude, namely, the extent to which computers are seen a beneficial tool and the extent to which computers are seen as independent thinking machines [7]. In a later study using the same instrument, Morrison proposed a four-factor interpretation which separated the independent thinking machines dimension into two "awesome machine" factors, and added a negative attitudes factor [12]. There is some evidence that the myth of the awesome thinking machine has declined as people have become better educated about the real nature and limitations of computers [9].

In contrast, Lloyd and Gressard identified the key dimensions as computer anxiety, computer confidence and computer liking [8]. Their Computer Attitude Scale, which measures these dimensions, has been applied by re-

[1] This research was supported by the University of Natal Research Fund

searchers such as Masoud [10] and Violata et al. [17] and modified by others. For instance, Byrd and Koohang added a measure of the perceived usefulness of computers [1, 6], a dimension which is perhaps similar to the dimension of value in [17]. The Computer Attitude Measure of Kay follows a different direction by focussing on the aspects of cognitive, affective and behavioural attitudes [5]. Rosen and Weil have undertaken numerous studies of negative attitudes to computers under the umbrella of computerphobia [13] (more recently broadened to "technophobia" [18]).

Attitudes towards computers should not be considered static. An individual's attitudes may change as a result of greater experience and understanding of computers (as shown in [3]), or in response to explicit intervention (such as the Computerphobia Reduction Program of Rosen et al. [14]).

While there have undoubtedly been numerous attempts to classify attitudes to computers other than those mentioned here, the two surveys in this study used a modified version of the instrument described by Lee. It may be argued that Lee's questionnaire is now somewhat outdated[2], but at the time of the first study it was still a popular instrument. The main motivation for using Lee's questionnaire in 1997 was to enable a direct comparison with previous data.

In South Africa there has been very little research into attitudes to computers since Finnie's report in 1987 [3]. In one study, senior students in four high schools were questioned with respect to gender/computer stereotypes, access to and time spent with computers, and enrolment in mathematics courses [11]. It is unfortunate that this paper gives no further details of the research method nor of the data collected. In a paper on teacher's attitudes to computers, an educationalist from University of Durban Westville collected ideas from overseas research, but could only include informal opinions about the situation in South Africa [4]. Given the growing significance of computers in both the South African economy and in education, one could, and should, conclude that further local research is necessary.

3 Methodology

3.1 How the Surveys were Conducted

In 1985, the University of Natal ran a first-year computer course for Commerce students called Business Data Processing 1. The first survey was conducted on 378 of these students and the results were published by Finnie [3]. By 1997, the Business Data Processing course had evolved into End User Computing and the class size had been increased by the addition of non-Commerce students. The second survey gathered data from 369 students in the End User Computing course, but in order to keep the two samples as comparable as possible, the analysis in this paper is based on the subset of 244 Commerce students.

[2]This is ceratinly the attitude presented in [5], though others have still used Lee's instrument since then (e.g. [16])

Since the survey was carried out during the first week of both courses, the structural differences between the two courses was not significant to the survey. Both surveys measured the initial attitudes of first-year university students at the same institution, and the current report is based on a comparison of these initial attitudes. The demographics of these students changed significantly over the intervening twelve years, especially in terms of gender (percentage of females increased from 32% to 45%), and race (percentage of Black Africans increased from approximately 5% to 24%, which probably also reflects a significant change in educational background). The effect of this is discussed in Section 5. The first survey also attempted to measure the changes in attitude during the course, but this was not replicated in the second survey.

3.2 The Survey Instrument

Several modifications to Lee's instrument were required by the South African context and the changes in language use since 1970. Lee's fifth statement "They are important for our man-in-space program" was considered irrelevant to South Africa and hence changed to "They are very important to the general economic development of our country". In the second survey, statement seven was made gender-neutral. We also considered the connotations of the word "machines" and decided to replace it throughout the instrument with "computers" for the second survey. The former is now rarely applied in the sense in which it was commonly used a decade ago, while the latter has now become a standard term in common usage. We judged that the 1985 connotations of "machines" were more closely matched by the present connotations of "computers" than the present connotations of "machines".

Since the 1985 survey needed to compare attitudes across three measurements, it requested the student's name. Although this was not required in the 1997 survey, the question was included for consistency.

The complete (1997) instrument is reproduced in the Appendix.

3.3 Method of Analysis

The 1997 sample of 244 Commerce students was factor analysed using SPSS with principal component analysis extraction using Varimax with Kaiser Normalization as the rotation method. Seven factors had eigenvalues greater than one but the five, six and seven factor solutions had factors which loaded significantly on only one or two variables and were poorly defined. The four factor solution provided the best set of factors for analysis.

Two tests for factor similarity were used for comparison with previous results : Pearson's r and Cattell's salient similarity test. (The same tests were used in [3]). 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, loadings in excess of plus 0.30 were considered positively salient for the factor, loading less than minus 0.30 were considered negatively salient and the remaining values were treated as being in the hyperplane and not having a significant loading on the factor.

The Pearson product-moment correlation coefficient r provides a measure of both pattern and magnitude of loadings. However it is possible to obtain significant values of r given that many variables may not load significantly on either factor and the use of the coefficient should be viewed as supporting the Cattell's index scores rather than having too much significance in its own right.

Two sample t-tests assuming unequal variance were used for comparison of factor scores between all student samples for the 1997 data set i.e. for gender, experience in computing and language and cultural differences. To compare the 1997 data with the 1985 data, z-scores were calculated using the means and standard deviations for each group.

The sample sizes were 244 Commerce students in the 1997 sample, 125 non-Commerce in 1997 and 378 Commerce students in the 1985 study. For the comparisons by gender and experience, the 1985 sample was reduced to 226.

4 Results

4.1 Attitude Structure

The structure of the attitudes towards computers has remained very similar over time. Student attitude still appears to consist of four major components, three of which have very similar structure to those identified in the earlier study.

- The first factor, labelled "beneficial tool of man" by Lee, is the major factor of both samples. The similarity between the two samples is very high ($r = 0.57$, $p < 0.01$, with Cattell's salient similarity index $s = 0.57$, $p < 0.001$). This factor shows a very positive view of computers, loading high on variables relating to the excitement of new technology ("bring about a better way of life for the average person", "free people to do more imaginative & interesting types of work", "speed up scientific progress and achievements", "extremely accurate and exact") and their value to the economy ("very important to the economic development of the country", "necessary to the efficient operation of large business companies").
- The second factor, which was termed a "fear of computer power" in [3], is also common to both samples ($r = 0.67$, $p < 0.005$, and $s = 0.5$, $p < 0.005$). This factor deals primarily with variables relating to possible negative impacts of technology on society and on individuals, in particular on the ability of individuals to control their own destiny. The factors loads significantly on statements dealing with the power of computers over people ("smarter than people", "can be used for evil purposes", "the individual will not count for very much any more") and the effect on society ("help to create unemployment", "may be running our lives for us").
- The third factor of the 1985 sample, "awesome thinking machines, or naive concern", is the same as the fourth factor in the 1997 sample ($r = 0.76$, $p < 0.0001$ and $s = 0.44$, $p < 0.001$). This factor has certain aspects of the "awe and wonder" of Lee's second dimension. It loads high on statements which appear to view computers with some astonishment ("strange & fascinating", "such amazing things that they stagger your imagination", "rather strange and frightening").
- The fourth factor in the 1985 sample has no direct match in the 1997 sample. This is not unusual in this type of analysis given that there were seven factors overall with eigenvalues exceeding 1.0 and with slightly lower contributions to variance. A similar situation arose in the 1987 study in comparing the four factor solution to the four factors extracted in the Australian study by Morrison [12]. This factor loaded on statements dealing with the potential of computers to replace people in important roles ("think like a human being thinks", "no limit to what they can do", "work at lightning speed", "make important decisions better than people").

4.2 Attitude Scores

Having established the similarity between the attitude structures of the two samples, attitude scores were then calculated using the factor weights from the 1985 study. Two types of analysis were performed: across time to see if attitudes had changed since the 1985 study and within the 1997 group to see if similar attitude differences existed to those identified in the earlier study. Some of the factor scores are taken from [2].

4.2.1 Sample of Commerce Students

The attitude scores for the two complete samples showed the following changes:

- Factor 1 (Beneficial tool of man) showed no significant change from 1985 (with a mean of 4.65) to 1997 (mean of 4.60). This indicates that students have not changed their perception of the usefulness and value of computers in a relatively abstract sense.
- Factor 2 (Fear of computer power and the role of computers in society) showed a highly significant negative change (1985 mean 3.31, 1997 mean 5.06, Z score of 13.82, $p < 0.00001$). The 1997 students have a far more negative view of computers in society than their counterparts of 12 years ago. For example, the later sample showed higher scores on such sentiments as "individual will not count for much any more", "running our lives for us" and "help to create unemployment".

- Factor 3 (Awe and wonder - a naive concern about computers) showed a highly negative change similar to Factor 2 (1985 mean 3.58, 1997 mean 4.58, Z score of 8.52, $p < 0.00001$). This factor loads on statements such as "strange and frightening", "stagger your imagination" and "going too far with these computers".

- Factor 4 (A positive view of computers perhaps related to an appreciation of the technical competence of computers) showed a slightly positive change (1985 mean 5.15, 1997 mean 5.41, $Z = 2.62$, $P < 0.01$). This increased appreciation is indicated by higher scores for such statements as "free people for more imaginative work" and "extremely accurate and exact".

4.2.2 Inexperienced Only

As a measure of experience of computer use, the students were asked whether they had attended any previous computer courses. Although this is obviously inadequate in the light of increasing use of home and school computers, it maintained consistency between the 1985 and the 1997 study and provides some measure of the level of prior experience. The subjects who had not attended any previous computer course showed attitude changes similar to the pattern in Section 4.2.1, as shown in Table 1.

4.2.3 Experienced Only

The subjects who had attended a previous computer course also showed attitude changes quite similar to the pattern in Section 4.2.1, as shown in Table 2. The only exception to the previous pattern was that the experienced students showed no significant difference for Factor 4 (i.e. no change in feeling about the "technical value" of computers).

4.2.4 Experienced Compared with Inexperienced (1997 Sample)

There was no significant difference on any factor between those students who had attended a computer course previously and those who had not. This was established by two tailed t-tests (unequal sample sizes, assuming unequal variances), as shown in Table 3.

The results for Factor 1 are interesting when compared to the earlier study. In the 1985 sample students with some experience of computers were significantly more appreciative of the positive aspects of computers than those without. There was also some indication in the earlier sample of lower scores on Factors 2 and 3 for experienced students (i.e. less fear of the computer).

4.2.5 Males Compared with Females (1997 sample)

There was no significant difference on any factor between males and females (see Table 4). These results are again interesting relative to the 1985 study. The earlier study indicated very clear differences in that females had a less positive view of computers (Factor 1), a higher fear of computers in society (Factor 2) and less technical appreciation of computers (Factor 4). Perhaps this indicates that the sex role issues in mathematics and computing have lost their significance over the past decade.

4.2.6 Language and Cultural Differences (1997 sample)

There were significant differences on Factors 1 and 2 between English and Non-English first-language speakers. This was established by two tailed t-tests (unequal sample sizes, assuming unequal variances), as shown in Table 5. The non-English speaking subjects (who were all Black Africans in this sample) exhibited a less positive view of computers as a "beneficial tool of man" and a higher fear of computer power and the role of computers in society.

4.2.7 Other Comments on the 1997 Sample

As mentioned in Section 3.1, the 1997 sample included not only the 244 Commerce students on which the above analyses are based, but also 125 non-Commerce students. When the full sample is studied we find that there is very little change in the areas of significant difference although the difference between English and non-English speakers becomes more pronounced (Table 6). There remains no significant difference based on gender or experience. There was also no significant difference on any factor between the Commerce and non-Commerce students.

4.2.8 Role of Prior Experience in Language Differences

The significant differences noted between English and non-English speakers raises the question of the role of prior exposure to computers in formulating attitudes. Typically, Black South Africans will have had less experience of computers in both formal and informal contexts. As noted above, our measure of experience was relatively weak as it only questioned whether students had taken a prior course in computing. However, it suggests that more detailed data on prior experience would be of value in further research on this topic. For this research, the sample of students who had attended at least one other computer course was analysed for significant differences between the language groups with the results given in Table 7. For students without experience, the differences between the language groups was the same as for the total sample.

In Table 7, the difference between scores on Factor 1 was the only one found to be significant. Although Factor 2 is not significant between the groups, there is still wide variance in the factor scores and the lack of significance is probably due to sample size. Unfortunately only 13 non-English speakers indicated prior experience which makes the validity of the any statistical analysis somewhat suspect. The results suggest that, for our limited measure of experience, prior exposure to computers may not account

	1985 Mean	1997 Mean	Z	p
Factor 1	4.45	4.64	1.73	ns
Factor 2	3.45	5.02	10.51	< 0.00001
Factor 3	3.72	4.64	6.35	< 0.0001
Factor 4	5.10	5.39	2.42	< 0.05

1985: n = 127, 1997: n = 193

Table 1: Attitude Changes for Inexperienced Students

	1985 Mean	1997 Mean	Z	p
Factor 1	4.79	4.67	0.79	ns
Factor 2	3.13	4.93	9.38	< 0.00001
Factor 3	3.41	4.37	4.52	< 0.0001
Factor 4	5.21	5.45	1.15	ns

1985: n = 99, 1997: n = 51

Table 2: Attitude Changes for Experienced Students

	Experienced Mean	Inexperienced Mean	t	p
Factor 1	4.60	4.64	-0.24	ns (0.8)
Factor 2	4.86	5.02	-0.81	ns (0.42)
Factor 3	4.31	4.64	-1.62	ns (0.11)
Factor 4	5.36	5.39	-0.14	ns (0.88)

Experienced: n = 51, Inexperienced: n = 193

Table 3: Difference Between Experienced and Inexperienced Students

	Male Mean	Female Mean	t	p
Factor 1	4.68	4.61	0.51	ns (0.61)
Factor 2	5.07	4.98	0.43	ns (0.66)
Factor 3	4.76	4.54	1.20	ns (0.23)
Factor 4	5.37	5.41	-0.26	ns (0.79)

Males: n = 135, Females: n = 109

Table 4: Difference Between Males and Females

	English Mean	Non-English Mean	t	p
Factor 1	4.78	4.19	3.59	< 0.001
Factor 2	4.87	5.47	-2.66	< 0.01
Factor 3	4.55	4.87	-1.46	ns (0.15)
Factor 4	5.43	5.22	1.21	ns (0.22)

English: n = 138, Non-English: n =50

Table 5: Difference Between English and Non-English Speakers

	English Mean	Non-English Mean	t	p
Factor 1	4.71	4.17	4.55	< 0.0001
Factor 2	4.92	5.80	-4.89	< 0.00001
Factor 3	4.61	4.81	-1.20	ns (0.21)
Factor 4	5.42	5.29	0.93	ns (0.35)

English: n = 270, Non-English: n =89

Table 6: Difference Between English and Non-English Speakers (Total sample)

	English Mean	Non-English Mean
Factor 1	4.78	4.01
Factor 2	4.68	5.52
Factor 3	4.23	4.73
Factor 4	5.55	5.47

English: n = 63, Non-English: n =13

Table 7: Difference Between English and Non-English Speakers (Experienced Only)

for the differences in attitude between English and non-English speakers.

5 Discussion and Conclusions

The attitudes towards computers of first-year university students were measured firstly in 1985 and then in 1997, using an instrument derived from Lee [7]. The structure of the students' attitudes changed little over the intervening decade, but the scores within that structure have changed. Although both samples displayed a strong sense of the worth of computers as beneficial tool, the subjects in 1997 held a far more negative view of the role of computers in society, and more "fear and awe" of computers, but an increased appreciation of the technical power of computers.

Within the 1997 sample, we found no significant difference in attitudes between students who had previously studied computers and those who had not, and no significant difference between males and females. However, subjects whose first language was English showed significantly more positive attitudes than other language groups.

The relevant literature shows a large degree of disagreement over the question of whether attitudes to computers are affected by gender [1, 10, 13, 15, 18]. In part this confusion may be due to differences in the sampled populations, and in part because the target is not stationary. Changes in the notion of gender as a social construct and changes in the position of women in education and in the labour force naturally lead to changes in their attitudes towards technology. What gender-differences do exist may not arise from gender per se, but from the lower level of exposure to technology experienced by women compared to men [18]. The literature is virtually unanimous in the conclusion that prior exposure to computers correlates to more positive attitudes, and so it should not be surprising that, as women gain similar access to technology as men, their attitudes to computers will grow correspondingly similar. This study supports such a conclusion by finding that the gender-based difference of a decade ago is no longer evident. Female attitude on the view of computers as a "beneficial tool of man" have changed positively (from 4.33 to 4.67) to match those of their male counterparts. Both males and females had strong negatives changes in attitude on the role of computers in society with any significant differences between the groups disappearing.

It is a little surprising that our 1997 sample did not show any impact of experience on attitudes, although the measure of "experience" was based only on the question "Have you done a computer course before?" Although one could assume that the overall exposure to computers and related technology is far greater now than a decade ago, the two samples showed a decrease in the number of students entering university having already attended a formal computer course (from 44% in 1985 to 29% in 1997).

Although the data shows more negative attitudes among students whose first language is non-English it is unlikely that the attitudinal differences relate directly to language. It is more likely that the attitudinal differences arise from the different cultural and educational background of English and non-English subjects. For instance, it is probable that the subjects with English as a first language attended secondary schools with greater access to technology. Since 1988, the Computer Society of Southern Africa's Adopt- a-School program has attempted to alleviate this imbalance by equipping disadvantaged schools with computer labs. It would be good to evaluate the success of this program by testing if the attitudes towards computers of graduates from the twenty participating schools differed from graduates from similar disadvantaged schools who have not benefited from the program.

A particularly interesting inference is suggested by coupling an observation from Section 4.2.6 (that the difference in attitudes based on first language in 1997 is similar to the difference in attitudes based on gender in 1985) with an observation from Section 4.2.5 (that, whereas the 1985 sample showed a significant difference between the attitudes of males and females, the 1997 sample showed no such difference). A useful avenue for further research would be to investigate the specific causes of the reduction in gender-based differences over the past decade. If this change was found to be related to other educational and social changes (such as increased access to technology, the de-coupling of computers from mathematics, the decrease in the prevalence of negative stereotypes and an increase in positive role models), then one may hope that the same educational and social changes, when applied to racial disparities, may result in a similar reduction in race-based differences over the next decade.

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A The "Attitudes to Computers" Instrument

Please write your name here -

Circle the answers to these questions -

Which degree are you enrolled in?	B.Com.	B.Soc.Sci.	B.A.	Other
What is your first language?	Zulu	English	Afrikaans	Other
Are you male or female?	Male	Female		
Have you done a computer course before?	Yes	No		

Indicate the extent to which you agree with each of the following statements by circling one number.

1: Strongly disagree		5: Mildly agree
2: Disagree	4: Neutral	6: Agree
3: Mildly disagree		7: Strongly agree

1. [1 2 3 4 5 6 7] There's something strange \& fascinating about computers with electronic brains
2. [1 2 3 4 5 6 7] Computers are rather strange and frightening
3. [1 2 3 4 5 6 7] They do such amazing things that they stagger your imagination
4. [1 2 3 4 5 6 7] They make you feel that computers are smarter than people
5. [1 2 3 4 5 6 7] They are very important to the economic development of the country
6. [1 2 3 4 5 6 7] They can be used for evil purposes if they fall into the wrong hands
7. [1 2 3 4 5 6 7] They will bring about a better way of life for the average person
8. [1 2 3 4 5 6 7] With these computers the individual will not count for very much any more
9. [1 2 3 4 5 6 7] They can think like a human being thinks
10. [1 2 3 4 5 6 7] These computers will free people to do more imaginative \& interesting types of work
11. [1 2 3 4 5 6 7] They are becoming necessary to the efficient operation of large business companies
12. [1 2 3 4 5 6 7] They can make serious mistakes because they fail to take the human factor into account
13. [1 2 3 4 5 6 7] Some day in the future these computers may be running our lives for us
14. [1 2 3 4 5 6 7] They make it possible to speed up scientific progress and achievements
15. [1 2 3 4 5 6 7] There is no limit to what these computers can do
16. [1 2 3 4 5 6 7] They work at lightning speed
17. [1 2 3 4 5 6 7] These computers help to create unemployment
18. [1 2 3 4 5 6 7] They are extremely accurate and exact
19. [1 2 3 4 5 6 7] These computers can make important decisions better than people
20. [1 2 3 4 5 6 7] They are going too far with these computers

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The prime purpose of the journal is to publish original research papers in the fields of Computer Science and Information Systems, as well as shorter technical research notes. However, non-refereed review and exploratory articles of interest to the journal's readers will be considered for publication under sections marked as Communications of Viewpoints. While English is the preferred language of the journal, papers in Afrikaans will also be accepted. Typed manuscripts for review should be submitted in triplicate to the editor.

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- an appropriate keyword list
- a list of relevant Computing Review Categories
- Tables and figures should be numbered and titled.
- References should be listed at the end of the text in alphabetic order of the (first) author's surname, and should be cited in the text according to the Harvard. References should also be according to the Harvard method.

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