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Comparing Students' Conceptions of Technology in a City Technology College and a Rural Comprehensive School

Andrew Hine

Abstract

This paper summarises the findings of a study which captured and compared the conceptions of Technology held by students in a City Technology College and a Rural Comprehensive School.

The first section provides a brief overview of the methodology which was adopted. The second section reports the major findings of the comparative study. The two student populations cannot be differentiated by virtue of the range of conceptions which one group holds being distinct from those of the other. However; a comparison is made based on the extent to which students in a school tend towards a common conception. The third section considers the learning environment and curriculum of the city technology college in relation to the TEC-Lab project reported by Householder and Bolin (1993) and questions if this influences students' awareness of technology.

Keywords

awareness, common, comparing, conceptions, curriculum, technology

Methodological overview

This section provides a brief overview of the methodology that was adopted – a detailed account is presented in Hine (1997). A student's perception is understood by this author to be evanescent in nature, a momentary impression which fades quickly; as a student reflects on these, they form their conception of technology which is the focus for this investigation.

The range of language available to describe technology is limited (Fores and Rey, 1986). The words used to describe aspects of technology have because of 'over use' become associated with a number of aspects and now convey only a 'global' meaning (Daamen, *et al*,1990).

To enable a less global, more descriptive, statement to be framed, six 'areas of interest' were identified as a framework in which a conception of technology could be constructed. This framework also provided the basis for subsequent comparisons. The following 'areas of interest' framed this investigation:

- recognising technology activity
- participating in technology activity
- which subjects teach technology
- living with technology
- influence on conceptions from outside school
- the products of technology.

These are by the nature of the inquiry concerned with school students. Other researchers might 'divide the cake' in a different manner; for example, Raat and de Vries (1986). If a sustainable argument could be presented showing that other areas should be included in this study then at worst the comparison of conceptions reported below would be valid but based on an incomplete view.

The use of a questionnaire with closed questions (agree 'A', disagree 'D' and don't understand 'U') was identified as the most efficient method of gathering data. The intention was to design an instrument such that the responses provided by a student could be displayed graphically, creating a response 'profile' within each 'area of interest' (rather in the style of the skills attributes profile used by McCarthy and Moss, 1990). The profile of one is to be compared visually with that of another. This visual profile provided no articulation of what an individual's conception actually was.

A 'matched' instrument and statement bank were developed. Responses to the questions in the instrument were processed to obtain a number of outcomes (Figure 1). The responses to questions in the instrument were processed via a predetermined transcription procedure which provided a record of each individual's

conception as a 29-section listing. Each of the ‘statement sections’ contained a code which identified a statement option derived from the transcription matrix for that section.

The listing of students’ statement option codes enabled statement options to be printed from the statement bank to produce the written ‘conception statement’, or enabled the visual ‘conception profile’ to be constructed. These codings could be reviewed to match identical lists and hence identify (within the scope of this inquiry) identical conceptions. The frequency of use of each statement could be determined and plotted (as could the response rate to specific questions in the instrument).

The reliability of the ‘conception statements’ was determined by interviewing a sample of students and comparing the interview comments with their ‘conception statement’. These students were given their ‘conception statement’ printout and were asked to confirm or comment on it.

The administration of the instrument was organised by the teaching staff in each school. The sample was an opportunity sample containing all those students who attended the technology lesson which the school had scheduled for completion of the questionnaire by that group. The sample of students who completed the questionnaire is summarised in Table 1.

	School Year Group				
	7	8	9	10	Total
City Technology College	82	32	—	118	232
Rural Comprehensive School	81	56	88	—	225
Pilot study school	58	71	52	—	181
Total student sample					638

Table 1. Summary of student samples

Comparing the conceptions

It would be incorrect to suggest that the conceptions of students from the city technology college (CTC) and the rural comprehensive school (RC) can be easily differentiated by virtue of the range of conceptions which one group holds being distinct from those of the other. In all but two statement sections (one in each school) a complete set of ‘option’ comments within each of the 29 statement sections was generated in both schools. It could therefore be argued that taken statement by statement (in all but two instances) any conception evident in one population is also evident in the other.

A comparison can be made of the two student samples based on the extent to which the students tend towards a common position. Taken within each of the areas of interest, students in the CTC population tend to have a more common conception about technology issues. They form fewer, larger groups of students holding the same conception, and the frequency of individual conceptions is lower than that for RC students. Figures 2, 3 and 4 show the size and frequency of groups holding the same conception and the number of different conceptions evident in the area of interest: ‘Recognising technology activity’ and ‘Living with technology’. The tendency for CTC students to form fewer larger groups is a recurring theme across all the areas of interest. Although individuals or small groups hold exclusive conceptions in both populations, the majority of one population does not hold a conception which is exclusive to that school.

CTC students are less likely to be uncertain about their position towards a given aspect of technology than their peers at the RC. Six statement sections contained an 'unclear', 'undecided' or 'uncertain' statement option. In five of these sections this option was, on average 6% more likely to be generated by RC students than CTC students. In the sixth section 'The products of technology' both student populations generated the comments as frequently. CTC students are less likely to respond to questions by using the 'don't understand 'U'' option. CTC students used the 'U' response for 3% of their total responses compared with RC students who used 'U' for 7.8% of total responses. The final title and position of the 'U' response were determined to reduce the tendency for students to use it as an 'easy' solution to challenging questions. From a lower 'U' rate it may be reasoned that CTC students had a clearer understanding of the aspects investigated in the instrument questions.

CTC students are more likely not to associate the use of products of technology as doing technology (CTC 28%, RC 20%). They are more likely to disagree with the notion that technology is a recent idea (CTC 77%, RC 52%); and that technology has always been related to human activity (CTC 78%, RC 73%). CTC students are twice as likely as RC students to view knowing how to gather information as being more important than knowing information about a specific field before starting a technology activity (CTC 22%, RC 11%). CTC students are more likely to view school subjects other than 'technology' as also teaching aspects of technology (CTC 93%, RC 79%). RC students are less likely to recognise technology issues in subjects such as religious education or history (RC 43%, CTC 68%). CTC students are less likely to see only products as the end result of technology activity (CTC 22%, RC 34%). The majority of both populations identify all manufactured products as being products of technology (CTC 56%, RC 60%) but CTC students are more likely to include 'soft' products such as new drugs or hybrid plants (CTC 34%, RC 18%).

The listing of student statement options was searched to identify any groups which held identical conception statement codes for all 29 sections. The total possible combination for options generated by the student samples provide for 2.6108×1010 possible conceptions. No students in the sample from the RC had identical conception statement codings, however two groups of students (two students in each group) were found to have identical conceptions in the student sample from the CTC. The search for identical conception statements was extended to include students in the pilot study. No identical conceptions were found in this sample of 181 students. It was not practicable to conduct a 'part match' (students with identical conceptions in two or more areas of interest) search of the listings sample.

In the pilot study investigation technology department teaching staff had agreed to complete the instrument (copies available upon request). The conception statements of two of the department staff differed in only 3 of the 29 statement sections. The probability of obtaining this match is $1:9.33 \times 106$. This match may suggest that in their roles as joint head of department they had discussed issues relating to the nature of technology.

The matching of CTC students with identical conceptions may support a further discussion about the influence of environment, curriculum or teaching styles on the development of a student's conception of technology. An attractive assertion would be that the influence of the CTC curriculum was evident in the matching of students, particularly given the situation of the two staff in the pilot study school. It must be noted that further investigation would be required before claims could be made that this matching of conception codes was significant.

Might corporate vision influence student conception?

The corporate vision of technology which was identified in the documentation of each institution was supported by the conceptions of its students. The research findings suggest that CTC students have an increased awareness of technology. The emphasis of its 'mission statement', the type of learning atmosphere and the reliance of its teaching schemes on the use of ICT suggest a technology rich environment in the CTC. In studying the response of students to a 'technology rich' teaching environment Householder and Bolin (1993) detail the atmosphere created by 'TEC Lab':

“The TEC-Lab incorporated a wide range of technologies, including computers, audio and video equipment, computer numerically controlled (CNC) machine tools, and satellite communication equipment.” (1993, p.6)

Direct parallels can be drawn between this environment and the provision for students in the CTC. One of the aims of the TEC-Lab project was to:

“determine the effect of immersion in a technology-rich environment on the attitude towards technology as displayed by the students in those groups” (*ibid*, p.5).

The summary of their report notes:

“The changes in student attitudes towards technology during the academic year are particularly provocative. Participation in the TEC-Lab project, whether in one of the TEC-Lab classes or in one of the comparison classes taught by TEC-Lab teachers, resulted in positive changes in attitude towards technology” (*ibid*, p.16).

It may be reasonable to suppose that a positive attitude toward technology may be accompanied by an increased awareness. If this ‘heightened awareness’ is enjoyed by CTC students then this may be a factor which is evidenced by a more certain response to questions about technology and a common experience which provides a strong base for common conceptions. Where CTC students may be revising issues, RC students may be considering these issues for the first time. The finding that CTC students are twice as likely to identify technology activity outside school than RC students also supports the notion of heightened awareness derived from a ‘technology rich’ environment.

Encouraging students to consider their conception of technology

The intention of this study was to compare the conceptions of technology held by students who followed two different models for technology in the National Curriculum. The methodology may provide a basis for further investigation of conceptions of technology and of issues of technology pedagogy, for example:

- how do students construct their conceptions of technology?
- can the development of a student’s conception of technology be considered in terms of readiness – like reading readiness?
- can an international comparison of students’ conceptions of technology be made?

The findings reported in this paper might promote discussion regarding possible changes to the nature of technology education. Readers might wish to consider some wider issues related to the role of the subject and other school subjects in developing technology awareness, and the type of curricular model which would be required to support this. At a national level such issues might be:

- should students have entitlement to ‘technology awareness’?
- is a ‘national common conception’ of technology desirable or achievable?
- could a common national conception be articulated and delivered by schools without over prescription of curricular documentation?

For a particular school or technology teaching team who wish to encourage their students’ awareness of technology (to challenge and develop their conception of technology) the findings of this study provide an indication of useful strategies. That the school (or subject team) has a clear corporate vision of the nature of technology which is supported by the learning experiences provided for students. That when technology issues are discussed in technology lessons, links are identified to the same issues as they relate to other school subjects; for example technology developments may cause ethical dilemmas considered in religious education. That students should experience a ‘technology rich environment’.

The nature of a ‘technology rich’ environment is still a matter for consideration. No doubt the technology equipment made available to the CTC students provides constant reinforcement of the school ethos and vision of technology. It would be interesting to consider whether in other schools the selection of curricular

materials and their delivery could be undertaken in order that students were exposed to an environment which was different to that of the CTC in terms of equipment but was still 'technology rich' in terms of learning concepts. This may have been the case in the comparison classes taught by TEC-Lab teachers where Householder and Bolin note positive changes in attitude towards technology.

However in reporting this study it should be noted that curriculum organisation is only one of a number of arguments which might seek to explain the difference between the two student populations. One school serves an urban community the other a rural market town. The aspirations of these two groups of students may be significantly different and may influence their interest in, and conceptions of, technology.

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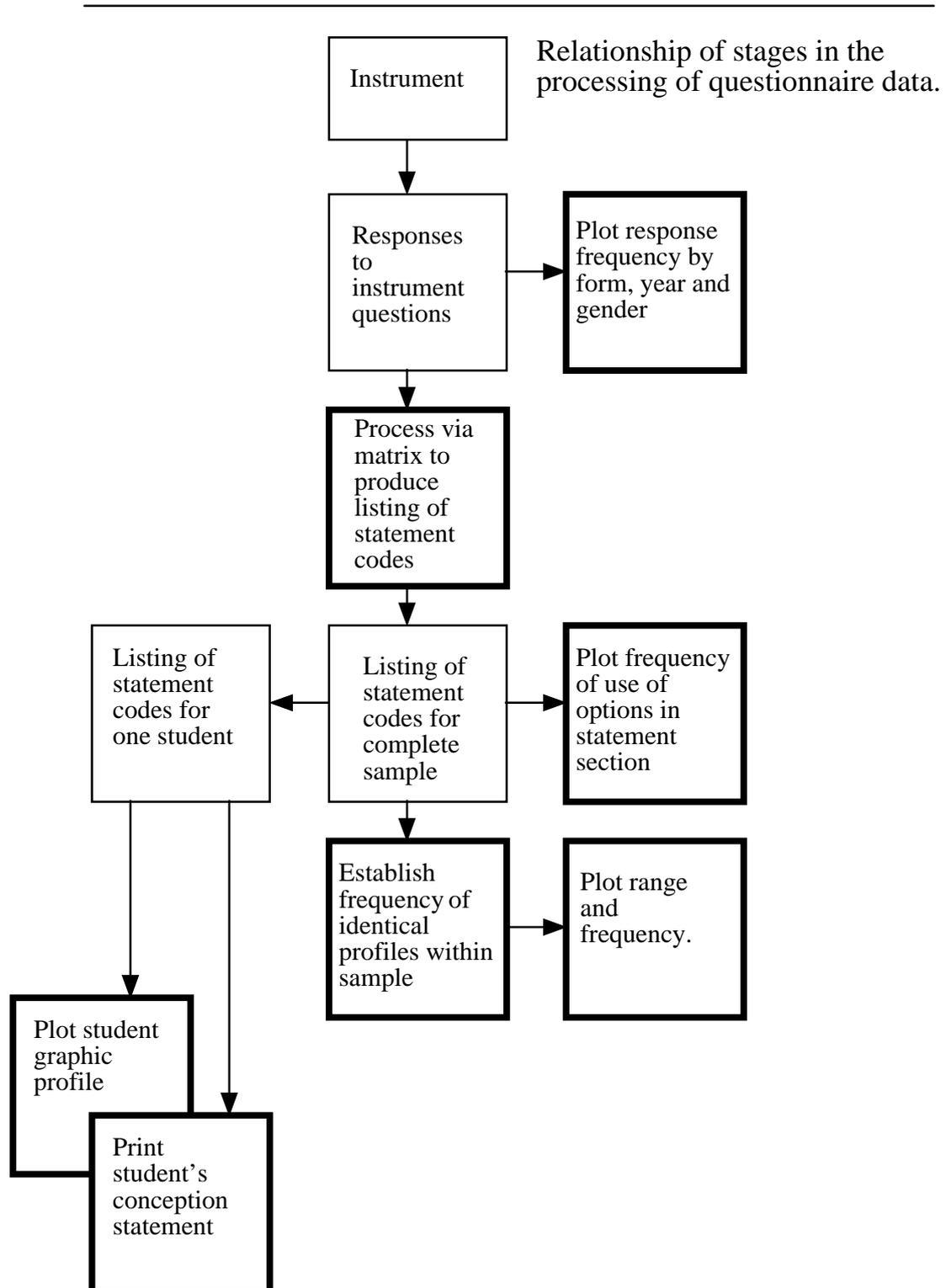
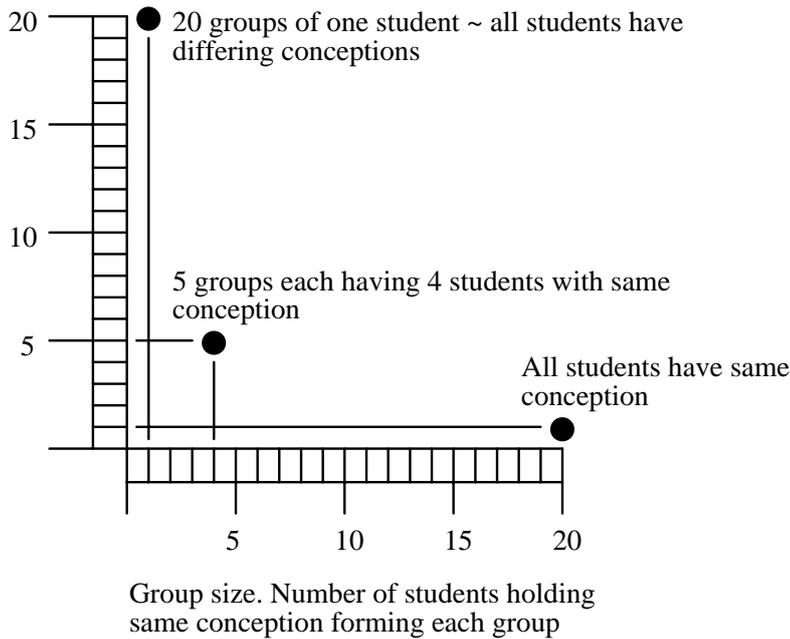


Fig 1

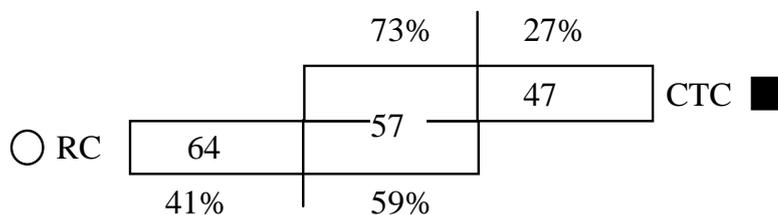


Scatter graph: explanatory notes

The scatter graphs also contain a graphic to indicate the range of conceptions which were identified in that area of interest.

The numbers in the box indicate the number of conceptions for that subset: conceptions exclusive to RC students, those shared by students of both schools and those conceptions exclusive to CTC students. The figures above the boxes indicate the percentage of CTC students whose conceptions form that subset. The figures below the box indicate the percentage of RC students.

In the example below; of 168 different conceptions identified in this ‘area of interest’ 57 were common to both populations of students - 73% of CTC students and 59% of RC students. 64 conceptions were exclusive to RC students (41% of their sample) and 47 conceptions were exclusive to CTC students (27% of their sample).



Total number of conceptions 168 of which 57 are common

Range of conceptions: explanatory notes

Fig 2

