Databases in Schools – some issues and approaches

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Introduction

Here the focus is on structured database programs (flat file or relational) as opposed to CD-ROM reference works, branching databases, Web etc.

Why use database software in schools?

a) To teach technical skills in using software
b) To teach about use in vocational and other outside contexts
c) To help learners to use data retrieval systems for everyday practical uses
d) To equip learners to use software in other contexts
e) To develop learners' thinking – cognitive development

> Secondary school practice often tends to place more emphasis on a) to d), while the best ICT practice in primary schools gives more weight to e). Why do you think this is? Review the use of databases in your own PTE schools. Does it match the schools' state objectives and their rationales?

Underwood and Underwood (1990) Chapter 4, *Building a world of information* and Chapter 5, *Questioning the file* provides a good introduction to the cognitive aspects. You are strongly advised to read these in detail.

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How does using a database promote thinking skills?

It is usually most effective to introduce pupils who are new to databases by using a fairly simply prepared database.

There should be a clearly defined purpose to the use – make sure that the pupils understand the overall objective, and do not see it as a meaningless exercise. Look for a context which is familiar to pupils or which is linked to a topic which they are otherwise engaged in studying.

The focus is on learning to use the *sorting* and *searching* facilities to find and analyse data: there are real questions to answer, and the database activity helps to answer them.

Younger children often find sorting easier to understand, especially if they undertake a sorting exercise with real objects or even people first – e.g. sorting the class into height order. Sorting at it's simplest requires comparisons between pairs of objects. Search implies more complex capabilities: *categorising* the objects concerned according to various attributes.

> Think about the possible implications of theories of children's intellectual development for progression in this area:

Once the pupil understands the purpose and use of databases and their information retrieval tools, they are better equipped to start to construct their own databases. They will need to understand something about the nature of structure databases - the meaning of file, record and field, different field types such as text, numeric etc, and why these are used. However, at least as important is the way the make decisions about how they will set up their *own* data files.

Pupils can confuse the *name* of a field and it's contents. Look out for this, and note the contexts in which it occurs. This may seem a superficial mistake, but it may well mean that they have not really understood the purpose of such structure. Rather, they are learning it at best by rote, as a strange eccentric incantation required by their teacher. Be alert for other such misunderstandings, and try to work out what they imply about the pupil's mental model of the process they are undertaking.

In this process they will need to think about which attributes of the objects concerned they will want to record, how they can best store them in a particular set of field within each record and why one structure may be more useful than another for their purposes. This implies thinking ahead about the kinds of queries they might want to apply to their file(s).

What can the teacher do to support them and to ensure that they succeed?

He or she could:

- Provide a ready-made structure. That will save time, and might possibly be appropriate if the focus is strongly on the contents of the data and the conclusions that could be drawn form analysing it. However, if the objective is teach pupils to plan for themselves, to analyses their needs in terms of the data they will collect and it's possible structure, this 'spoon-feeding' will undercut much possible cognitive development.
- Facilitate the pupils in planning and thinking through the problems, using techniques such as class or group discussion, brainstorming, fish- boning, mind-mapping
- Provide partial examples, perhaps with deliberate 'errors' and model the process of criticising them in front of pupils. These examples might use the actual software, which will be used, or they could use manual methods such as large file cards, to make the processes involved more concrete for pupils. [1]

The way that data is stored within fields is another issues that pupils will come to understand. When deciding on field types, pupils will think about which data can be quantified and stored in numeric fields, which requires text fields, date fields and so on.

The decisions don't stop there. Pupils often want to use distinctive textual descriptions for each object, with no consistency in the terms or vocabulary used. Later they find that it's not possible to search such data effectively. Perhaps using standards codes would be better? There are advantages and disadvantages her. Coding makes data quicker to enter and saves storage space. It may allow automatic *validation*, perhaps against a list of permitted values. It ensures consistency, so that the user of the file knows what values they can search for. In a learning context, thinking about which codes to use may clarify aspects of the topic – a possible theme for brainstorming activities, perhaps? On the other hand, coding means that the person entering data needs to use a reference to the permitted code, either manual of embedded in the data entry form. The meaning of the data becomes less transparent. Codes can be inflexible: sometimes instances arise that don't fit well. Some criticisms of database use claim that this process gives exaggerated importance to information that can be easily categorised (Beynon and McKay, 1992).

- [1] I've used cards with holes manual punched for each of a number of yes/no fields to do this. To code a *yes*, a hole is punched, to code *no*, a slot is cut. Then a rod (perhaps a knitting needle) is pushed through and lifted. *Yes* cards come up with it, *no* cards are left behind. This provides a simple concrete demonstration of the idea of conditional searches, and echoes the principle used in old Hollerith-type machines before the modern computer was developed

Underwood and Underwood (1990) p.77 describe a research project involving 8-year-olds investigating pedestrian safety around their village. First they had to formulate a good research question: without this it would be impossible to decide on the best way to organise and store their data. They then conducted a filed survey. However, they made a mistake: the selected features that they believed would affect road safety such as zebra crossings and blind corners. Then they built their data file with a record for each of these features.

> "They quickly realised that an organisational structure such as this which used such features as record and then used the criterion of place to designate fields, was not going to be effective. The spatial component, 'where' a hazard occurred, was critical to the solution of their problem. They needed a place name to be returned as the meaningful answer. This led the children to restructure their data files and to enter data into place-name records with road safety features defining the fields. Transposition of data in this way is a highly skilled activity. Should we be surprised that the children succeeded? … Crossing the road had meaning for these children…" (Underwood and Underwood 1990 p.77).

The process of reconstructing their file was hard work, but the children learned from it, for their initial mistake. They were not demotivated because the task was meaningful and challenging in a way that engaged their interest.

If a whole class or large group is to construct files and then enter data into them, the teacher will need to plan the process carefully. Should each pupil construct his or her own file? If so, should they agree on a common structure before they start? That might mean that smaller files could be merged. Or should pupils take turns to enter data into a single file? How will this be managed, and what will pupils be doing when it isn't their turn?

When pupils are entering data, they will almost certainly make errors. Of course, learning why errors matter and how they can be minimised is an essential part of the IT National Curriculum.

How can errors be detected and corrected

(a) at the point of data entry

(b) once the file is complete.

Review what you know about data validation techniques.

- What facilities are provided by the data handling software in your schools?
- When is the most appropriate point to introduce pupils to these?
- If the software lacks such sophisticated features, is it possible to devise ordinary search/query criteria that would show up common errors, perhaps implementing a range check by these means?

Does the context of the database activity provide useful examples for pupils of potentially harmful outcomes form inaccurate data? How does this relate to the Data Protection Act and other statutory requirements?

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Analysing existing data files.

Whether they have created the files themselves or use one provided by the teacher, the teacher will be responsible for leading them to a greater understanding of the ways in which their "information retrieval"[2] package can help them analyse the data and draw conclusions.

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[2] The term 'information retrieval" is used widely, but is it accurate. Is what is retrieved information, or is it data? How does this relate to 'knowledge' or 'ideas'? Theodore Roszak in *The Cult of Information* (1986) has some challenging things to say about this.

They will need to know about the technical means by which they can search and sort, of course. However, the greater challenge is to understand the underlying principles, and when it is appropriate to apply them for particular purposes.

At first, sorting may produce worthwhile results, and is the simplest function to understand conceptually (as discussed above). Simple searches or queries using a single condition can follow on, perhaps used to split the sorted list into subsets using *greater than* and *less than* comparisons. Combining conditions using AND or OR conditions makes greater demands on the pupil's understanding.[3] Used carefully, however, a database activity can help them to make the conceptual leap to understanding that the objects concerned can have a number of different attributes, each of which can form the basis of a conditional search. It's not a once-and-for-all revelation, though; such and understanding will need to be explicitly rehearsed in a range of contexts to ensure that pupils grasp the general point.

Pupils are often confused by the special meanings of the word AND and OR in searching databases. AND usually implies that we have more objects (We've got apple as and oranges and…") or that the range of possibilities is widened ("You can have orange juice *and* cornflakes.."). OR usually implies a narrowed range of possibility in everyday life ("You can have dessert *or* cheese…"). In Boolean logical as it's applied to searches, the meanings are *precisely opposite*: Using OR widens the set of objects that may be found, AND restricts it. This is another instance where concrete 'worked examples' as well as carefully explanation are likely to be essential.

Think about how you would provide such examples, and what terms you would use to explain this point to pupils.)

You will want to provide opportunities for pupils to explore the ways in which software allows them to present data for their own use in analysis or for other audiences. For example, creating charts and graphs based on different sub-sets of the data may be very revealing. More powerful databases often have reporting facilitates that can tailor the presentation of results.

The manipulation of structured masses of data is central to the computer's history. It is not surprising that it plays a central role in education ICT, as well. You will certainly find yourself teaching about the use of databases in the wider world, and the issues, problems and solutions that arise in business, management and administration. However, don't limit you thought and database activities to these aspects. Databases can be valuable "tools to think with" too.

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Recommended reading:

Beynon, John and Mackay, Hughie ed (1992) *Technological literacy and the curriculum.* London: Falmer, Nab Loyx

Beynon, John and Mackay, Hughie ed. (1993) *Computers into classrooms: more questions than answers.* London: Falmer Press, Loz BEY

Roszak, Theodore (1986) *The Cult of Information: the folklore of computers and the true art of thinking.* Cambridge: Lutterworth Press, Lozx Bag ROS

Underwood, Jean DM and Underwood, Geoffrey (1990) *Computers and Learning: helping children acquire thinking skills*. Oxford: Blackwell, Loz UND

Review guidance and exemplification materials from NCET/BeCTA, SCAA/QCA etc. to see a range of database activities in subject contexts.

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