

The preconditions for computer-assisted decision-making in tomorrow's schools

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Abstract

This paper is a summary of a multi-session group discussion among the listed authors in which they deal with three broad questions: What sorts of decisions need to be made in schools? What kinds of computer assistance would be helpful? What are the barriers to obtaining this assistance? Several general conclusions are reached, touching on the importance of the articulation of agreed-upon objectives, developing confidence in the assistance computers can give, the need for collaboration and group decision support, and the need for rigorous research.

Keywords

Decision-making, decision support systems

1 OPENING NOTES

For the purposes of this paper, and in the context of education, Computer-Assisted Decision Making (CADM) is defined as follows: "CADM is the use of information and communications technology to support decision-making at all levels of the school: managers and management, teachers and teaching, and students and learning." In this context, management should be defined broadly and should include both the management of the classroom and the learning process.

The starting point for any analysis or discussion of CADM must be with the sorts of decisions that need to be made, and not on the methods or the technologies related to CADM. The temptation is to embrace the technology without first being clear about the purposes for doing so. By focusing on the nature of the decisions first, CADM becomes an important subset of the broader topic of Decision Support Systems.

Once the decision or decisions are articulated, there is a continuum of ways information and communications technology can be supportive:

- by facilitating the process by which a person or group approaches and reaches a decision;
- by retrospectively justifying the decision;
- by making the decision;
- by taking the decision.

The above-mentioned issues can be organized and discussed around four basic groups of questions:

- What kind of decisions need to be made in schools?
- What kind of computer-assistance would be useful?
- What are the barriers to obtaining such assistance; how can they be overcome; what resources are needed?
- What overall conclusions can be reached; what suggestions can be given?

2 KINDS OF DECISIONS

Rather than attempting to provide a typology of decisions, a short list of examples is given below. This list serves to illustrate the range of decisions that must be made by those who manage education, either individually or within a group. By no means is this list exhaustive or even comprehensive.

- Perhaps the most general and most enduring problem in school management is having to choose among alternatives in the absence of good information. This kind of decision-making context presents itself everyday and at every level of the school's organization.
- Another problem is discerning a pattern within a complex set of data. For example, given a rather complete pupil tracking system, are there any patterns within the data to suggest that an intervention by the school counselor into a particular student's school life might save the student from some undesirable consequence?
- Without understanding or analyzing the inner mechanisms of certain complex situations, when is it possible to come to a conclusion or make a decision based strictly on prior evidence or experience? This problem is akin to evidence-based diagnosis as used in the medical profession. If I make a certain decision, what is the probability that I have done the best thing? Or, put differently, given past experience, what is the most likely outcome for each alternative, and how severe is the down-side consequences if I am wrong?
- Clearly, the context of some decision-making situations are better structured than others. Contexts that are low in structure often present a mix of data types, from well-behaved quantitative variables, to qualitative variables, to variables with missing and/or fuzzy values. Add to these complications the typical additional demands of low resources and competing priorities, and the decision-making environment is about as difficult as it can get. For example, what is the best allocation of instructional time to each of several subject areas for children in a given class?
- At the other end of the continuum of structure, are problems that are largely quantitative and have an easily agreed-upon objective. Usually, setting a master schedule (rooms, teachers, courses, time periods) is representative of such a problem.
- Some decisions may be relatively easy to make once there is consensus on which inputs are important and which are not. Such consensus may be hard to obtain because the individuals involved will suffer or gain substantively by the outcome. Many human resource management policy decisions fall into this category.
- Other decisions may also be relatively easy to make once there is consensus, but they carry the burden of being regarded as irrelevant by some or nearly all of the persons who are asked to make them. Adopting a mission statement and a set of institutional objectives is illustrative of such decisions.

- Some problems are well-structured but are based largely on social utilities that may be very hard to measure reliably. For example, how are decisions regarding the measurement of student progress, teacher effectiveness, and student promotion to be made?

3 CADM

There are many possible criteria for deciding when and how CADM should be used within a Decision Support System. The follow are examples:

- Is the problem structured or non-structured? Or, to restate the question, how well is the problem structured? Arguably, the appropriateness and the utility of CADM are positively correlated with the degree of structure.
- How efficient is the use of CADM likely to be? Or better, what is the benefit-to-cost ratio and is that ratio attractive?
- Are the inputs measureable? Generally, the more measureable the inputs, the more easily CADM can be employed.
- Is there really a decision to be made? There are many situations in education where it appears as though a decision is being made by a certain leader or group, but, in fact, many other individuals actually make the decision for themselves. How many curriculum committees, for example, have spent hundreds of man days making pedagogical decisions, only to have every teacher (including members of the curriculum committee) close the door to their classrooms and do whatever they want?
- Is the decision well-articulated? If not, how are we to know what decision needs to be made? Neither CADM or any other tool is useful if the decision cannot be expressed unambiguously.

4 BARRIERS

There are numerous barriers to the full implementation of CADM in schools, even for those decisions which are clearly amenable to such an approach. These barriers run the gamut from purely psychological constraints to limits on the state-of-the-art in computing to such practical matters as cost. The following is a brief list of such impediments to progress:

- On both a theoretical and practical level there is often a paucity of empirical models appropriate for a given situation.
- Or, when such models exist, they are not well understood by the persons using the CADM system. Thus, the need for training and cross disciplinary communication is a substantial constraint.
- CADM is confronted by all the usual attitudinal barriers customarily associated with organizational change and the adoption of technology.
- What is not well understood, is often feared or distrusted. Thus, the lack of training and experience feeds lack of confidence towards the models used. An addition, there is often a healthy distrust of the quality of the data, especially in environments where there has been no long-standing and rigorous standards for the collection and recording of information.
- Although in the long run, the costs of CADM may clearly offset the development costs, the initial investment may be prohibitive to the institution. Thus, the economic issues relate both to the cost-to-benefit ratio and initial capitalization.

- CADM deals with decisions and, only peripherally, helps with the formulation of goals. Thus, in the absence of goal congruence among the decision makers, CADM is not relevant. An institution that lacks well-articulated goals, congruent among the major players or constituencies, is not a good candidate for CADM.

5 CONCLUSION

- Do not use decision-making or decision-taking systems when there are no clear institutional goals, or even when the goals and purposes of the support system are unspecified. CADM is a tool for people and organizations which have a reasonably clear idea of where they are trying to go.
- Adopt a sensible and conservative implementation strategy. For example, install well-tested and trustworthy CADM applications into schools, let the people there get some experience with these CADM components, and let confidence grow, before adding complexity to the support system. Perhaps it would be best to start with decisions that are reasonably well-structured.
- Although it is always appropriate to suggest additional research, CADM in schools is a radically under-research area. In the case of hard deterministic data, the outcomes of CADM are likely to be somewhat predictable. However, for soft and probabilistic data, the likely outcomes are much harder to anticipate. Thus, research needs to include this latter more-difficult area.
- For many problems and in most organizational structures, group decision-making is more effective than top-down or one-man decision-making. CADM is an ideal tool when mixed with group work, because it adds data richness to people richness. A manager that does not care to tap into the reserves of knowledge and skill held by people, is unlikely to want help from a machine.