A FIRST STEP TOWARDS THE AUTOMATION OF SSM?

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INTRODUCTION

A strength of SSM lies in the hermeneutic/phenomenological process of inquiry. The methodology is an operationalisation of Vicker's notion of appreciation which helps both practitioner and client(s) to gain an understanding of the perceived problem situation. The appreciative process applies equally to the practitioner as it does to the client(s) and seems to rely to a great extent upon the interaction that takes place between them. An important feature of SSM is that it offers a means of appreciating the problem without imposing the structure of some predetermined model. It would seem therefore, that the idea of automating SSM is dialectically opposed to the principles that underpin the methodology. However, an investigation has been undertaken to explore the possibilities of applying information technology to some aspects of the methodology. This paper will describe the research which has explored the possibility of incorporating the methodology within an expert system framework.

CAN SSM BE AUTOMATED?

Our reaction to this proposal was, at first, negative but upon reflection we realised that this was to take the proposal too literally. The idea of attempting to program a methodology which is claimed to be phenomenological in concept (Checkland, 1981) was to take on an impossible task. However, the idea of providing a computer based leaning package to aid the student of SSM in his endeavours was less daunting. The computer as an aid to learning has many advantages. It never tires nor loses patience, it can provide a stimulating interaction and possesses novelty (at least for the first few attempts at using it). We decided to contemplate the use of an expert system as a means of supplementing tutorials.

EXPERT SYSTEMS

There have been many different ideas expressed about the nature of an expert system, but few find universal acceptance. We

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would argue that an expert system should be viewed as a tool for use by a human to aid both decision-making and learning. The expert system should be seen as an aid but the responsibility for resultant action is that of the human and not the machine. Waterman (1986) argues that in order to carry out this function expert systems must have: (i) a knowledge base which contains a representation of the knowledge that is required, and deal with subject matter of realistic complexity that normally requires a large amount of human expertise. (ii) An inference mechanism which is the means by which this knowledge is handled, and through which it must be capable of explaining and justifying solutions and recommendations. (iii) An input/output interface which enables the user to supply facts and data, and enables the expert system to ask questions or supply advice and explanations.

SHOULD IT BE DONE?

In many instances SSM is taught as one of a number of problem-solving methodologies and all within a tight allocation of time. Students who find the methodology of interest often use the tutorial time to discuss the concept of SSM and their own time to practice the ideas. It seemed to us that the addition of a computer aided learning package to the reference texts (e.g. Checkland, 1981, 1990 and the Open University) could be a useful tutorial aid.

DEVELOPING THE EXPERT SYSTEM

One important question we needed to address before developing the expert system was to identify which aspects of SSM were to be chosen for incorporation into the expert system framework. Second, and an equally important problem, was to identify the limits of the knowledge bases which were to make up the expert system. The answers to these questions were to be found in an examination of the fundamental uses of expert systems, namely in providing advice and solving problems. Thus a potential area of SSM which might form the basis of an expert system application was in the teaching of the methodology. In adopting this aspect of SSM, the limits of the knowledge bases were to be determined by the seven stages which make up the methodology itself. Thus, the aspect of SSM to be adopted for incorporation into an expert system framework was to be a computer aided learning approach in developing the skills and knowledge required to become a competent user of SSM. The area of application was therefore identified, as was the boundary of the knowledge bases.

Knowledge Elicitation

An area of fundamental importance to the design of an expert system was that of acquiring the knowledge. The process of knowledge acquisition is the process of acquiring the knowledge needed to power an expert system and structuring that knowledge into a usable form. The knowledge acquisition process used to form the basis for the design of the expert system was both structured and iterative. The main methods of knowledge elicitation that were used were prototyping and interviewing with the

use of questionnaires and "talk throughs" for interesting and "live" examples in which SSM could be applied. Many inadequacies and problems were found to exist with these so called 'traditional' knowledge elicitation techniques, which were highlighted by this exercise. The difficulty, we would argue, in using SSM relates to the practitioners appreciation, consciously or unconsciously, of these underpinning philosophies. Checkland and Scholes make a similar point when discussing the way in which SSM is used and the results obtained by the various practitioners (Checkland and Scholes, 1990). But this has been discussed elsewhere and is not the subject of this paper, (see Stowell and West, 1987; 1988; 1989; 1990).

Building the Tutoring System

The approach adopted in the design and development of the tutoring system was a modular approach. This involved splitting it into sections, designing and developing a prototype for each section and after validation linking the separate sections together to form the overall expert system itself which was subsequently called "SSM AID". The tutor system was developed using a rule-based expert system shell. The shell fits well into the modular approach as a knowledge base could be designed and developed for each of the sections which made up the expert system and the separate knowledge bases linked together to allow a smooth interaction between the various sections which make up the overall tutoring system itself.

A number of important considerations had to be addressed in designing the second part of the tutor system, which dealt with the learning and teaching aspect of SSM. These were that it should, (i) be user friendly. (ii) easy to use and involve minimal training. (iii) be designed to account for different levels of userability. (iv) encompass all of the stages of SSM in some way, whilst preserving the essence of the methodology by not imposing tight constraints upon the user.

Overview of the Tutoring System

The tutoring system was designed to take the user through each of the stages of SSM, providing tutorial exercises at each stage. Each stage of SSM was divided into three levels: an overview of the stage, specific guidelines in carrying it out and a tutorial where the user would be able to compare their answers to that of an expert's. It was also considered important that the user should be guided through the stages of SSM using one specific example as well as more general examples. Each stage then comprised of examples to help the student with understanding and one of the examples was developed through the whole exercise.

The main direction of the stages 1 and 2 section was confined to providing the user with advice and guidelines in the compilation of rich pictures. There are no established techniques to guide the user of SSM in carrying out stage 1 of the methodology which involves a detailed exploration of the problem situation whilst trying not to impose a structure. The recognition that much of this stage of SSM is dependent on the judgement of the analyst through experience which cannot be gained through the use of a computer-based tutor system.

The overview section of the rich picture stage provides the user with a basic background and introduction to the "finding out" stage and its relevance within SSM. The guidelines section provides the user with advice and guidelines for drawing rich pictures. This is followed by the tutorial exercise which is based on presenting the user with a problem situation and a series of rich pictures. Initially these were drawn using a software graphics package and shown on the screen. The user is asked to choose which rich picture they think best depicts the problem situation. Following this they are given an expert's view of the rich pictures. The final part of the tutorial centres around the user being presented with another problem situation scenario and asked to draw a rich picture of their own relating to the problem situation. The student is then given the opportunity to compare their rich picture with that of an expert's.

A fundamental problem exists in the reproduction of hand drawn rich pictures to graphically drawn pictures using software packages. It is our view that while the structure and the process may be covered, the climate is largely lost (A similar point about this aspect of representaion is made by Anderton, 1990). A rich picture produced using a graphics software package is largely 'clinical' and 'clean' preventing the viewer from gaining a 'feel' for the problem situation. However, this problem is cuurently being addressed through the use of a scanner which has made possible the display of hand drawn rich pictures onto the visual display screen.

Stage 3 of SSM is centred around providing the student with advice and guidelines relating to the formulation of root definitions. An important point which is highlighted is the two main types, issue-based and primary task systems. The 'CATWOE' test forms the basis of the tutorial exercise in which the student is asked to carry out the test on three root definitions, which include both abstract and "real world" examples. The user is then able to compare their ideas with that of an expert's which is shown to them after their attempt.

We considered the possibility of carrying out a word check to identify key words that should be included in an answer to the 'CATWOE' test, however, some of the answers to the 'CATWOE' test may be implied or not stated in the root definition. More importantly the "Weltanschauung", or world view is dependent upon the personal view of an individual. We decided therefore to reject the idea of a word check as in practice this was a difficult stage to develop since each expert had their own view regarding "Weltanschauung". We warn the student that the expert's answers are only meant as a guide and should not be taken as definitive answers.

The part of the tutoring system aimed at providing advice for stage 4 of SSM centres around the building of conceptual models. Stage 4 of SSM is concerned with modelling the activities required to achieve the transformation process described in the root definition, and is in no sense a description of any part of the "real world".

The guidelines section at this stage concentrates upon providing the student with advice on building conceptual models and the use of the 'formal system' model. The 'formal system' model forms the basis of the stage 4 tutorial. This is achieved through the redrawing of an expert's conceptual model, gained from the knowledge acquisition stage. This is achieved by using a

graphics software package which was then saved as 'pix' files and called up in the knowledge base and displayed on the visual display unit.

The student is offered a choice of three conceptual models, which include both abstract and "real world" examples, and asked to fill in their answers to the 'formal system' model. Upon completion of this stage the student is able to compare their answers with that of an expert's view. Again the expert's answer is only meant as a guide.

The part of the tutoring system concerned with stages 5, 6 and 7 of SSM concentrates on advising the user on thinking about and then bringing the relevant system back into the "real world". The purpose of stage 5 in SSM is to decide if the conceptual model does offer useful ideas about the system relevant to the perceived problem situation, and if so what steps could be taken to change the situation so as to improve it. This section of the tutor system is concerned with first, providing the user with guidelines and different ways of carrying out the comparison stage, and, second a tutorial exercise to help the user to gain some practice in developing an agenda. The guidance is provided through the use of a tabular display on the visual display unit.

The advice provided to the user in carrying out stage 6 of SSM centres around the fact that the agenda should be used to structure a debate and any changes should be both systemically desirable and culturally feasible. The final part suggests useful references that we consider to be important for the student to read.

Although the tutoring system covers all seven stages of SSM, the stages that seem to work best are stages 2, 3, 4 and 5, where clear guidelines are provided in carrying out these stages. Stages 1, 6 and 7 do not seem to integrate well into an expert system framework since no clear guidelines and methods exist to carry out these parts of the methodology, relying in some part on the experience and judgement of the user: This difficulty, perhaps, highlights the deficiency of computer-based expertise.

EVALUATION OF SSM AID

The final version of SSM AID offers more than we originally conceived in as much as it does guide the students through the methodology as a whole. The feedback that we have had from students is encouraging. The tests to date have been limited to a small number of students and also to students who have already completed the SSM part of the MSc course. Consequently, it is not possible at this stage of the project to report accurately if the developed package does help with the teaching phase of SSM. Our observations, therefore, should be taken within this context.

The advantages of using the package seem to be; (i) The facility to work privately through several graded examples of each stage of the methodology. (ii) Feedback is provided for each example attempted. (iii) The tutorial examples include a case-study to enable a student to work through one iteration of SSM. (iv) An explanation of each stage of the methodology is provided as the student progresses through the tutorial.

We see an important feature of the computer-aided tutorial package as allowing a student to work at a series of exercises at

their own pace. Each exercise is graded in terms of difficulty thus providing the facility for a student to select an exercise according to their needs. There is also a case-study which allows a student to work through one complete iteration of SSM with feedback comments provided through the package.

Attempts to make the Rich Picture and Conceptual models as "life-like" as possible have met with only partial success so far. There is still a hint of computer graphics about the results which, in our view, detract from the essence of SSM as a subjective methodology. We believe that the models used within the tutorial package should seek to preserve the "cultural" implications of the problem situation rather than a technological interpretation. The way that an individual wishes to represent a problem or conceptual model is, in our view, an aspect of the methodology that should be preserved. The limitations that a graphics package may impose upon stages 3 and 4 is one undesirable feature that we feel a computer-based approach may impose. However, we expect to overcome in this difficulty in the near future.

Our purpose in producing this package was provide an additional aid to conventional tutorials rather than as a replacement for tutor/student interface. We see the package as one means of supplementing, in a dynamic fashion, the material available on SSM. However, a potential danger that a computer-based tutorial package may impose is that the way in which the tutorial is presented may convince the user that SSM can be learnt in a mechanical fashion. One danger of the approach is that the student may be constrained into thinking that once the machine has been defeated, by answering the questions correctly, then the task is also completed. We have attempted to overcome this by stressing within the tutorial sessions themselves that the "answers" provided are expert views of the situation and should be used for guidance and illustration rather than a model answers. Our decision to adopt this posture does of course provide those critics of SSM with the opportunity to suggest that here is an example of the equivocal nature of the approach. However, we feel that the alternative would be to create a package which would be more suited to teaching a technique than SSM. We consequently rejected the idea of infering a set of "right" answers.

The package will take the average student approximately 4 hours to work through but it is not necessary to work through the whole tutorial in one sitting. The package is designed so that the students can use if for short sessions if that is the preferred mode of working.

CONCLUSIONS

The production of SSM-AID has broken the spell, for us at least, of employing computer assistance with SSM. We feel that the exercise shows the potential for information technology to be used with SSM and without jeopardising the essence of the methodology. Results so far are encouraging and it is intended to produce a more robust version for wider application. The production of a computer-based tutorial package as an aid to the teaching of SSM has, we believe, much to offer to the student of SSM.

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