

# MECHANISM AND SOFTWARE DESIGN: THE USE OF A STOCHASTIC SOCIAL-PROCESS ALGORITHM IN THE DESIGN OF A WRITING TUTOR PROGRAM

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**ABSTRACT:** *One of the chief difficulties in designing effective courseware for improving writing proficiency is that composing, like other forms of human communication, is a complex social process with little or no agreement as to its precise nature or structure. Designing a versatile writing tutor program which will mimic the functions performed by a human tutor requires a systematic investigation into the complex processes involved in composing, in particular its commonalities and variables, and the ways in which it is shaped to the various contexts in which it occurs. This paper suggests that in order to translate complex social processes effectively into educational software design, it is first advisable to discover the social mechanisms which effect the process. In the case of written composition, a complex modelling procedure was followed which used a process of reverse engineering to arrive at a system of essential communicative functions. The architecture of functions thus revealed validated a practical model of composing, which in turn could be seen to constitute a stochastic algorithm for composing. The algorithm was used as the basis for the design of a writing tutor program, which took the form of a help menu based around the five stages of composing depicted in the algorithm. The program has still to be tested out by learner writers working in various educational contexts.*

## 1. INTRODUCTION

In the field of program design algorithms tend to be associated with programming routines. However, human social processes, no matter how open-ended, can also be seen to be driven by algorithmic-type mechanisms, comprising complex layers of contingent and intentional factors, much of which is not observable. In this

account I shall attempt to illustrate how establishing complex social mechanisms at the outset of the design process can make it relatively easy to translate many of the key functions performed by a human tutor into a computer help facility for learner writers which they can access for instruction and advice as they compose on computer. The term “tutor” when applied to courseware is often used loosely for any instructional programme run on computers or off the Internet [1]: it is used here to indicate an application which will imitate the functions of a real human tutor in giving both specialist instruction and advice to learner writers engaged in composing. As increasing numbers of students are now composing on computer, and individual tutoring is neither time- nor cost-effective, the notion of a computerised writing tutor which can be customised to suit different academic contexts is becoming less of an oddity and more of a necessity. While such a writing tutor must perforce lack the interactivity and spontaneity of a human tutor, it does possess advantages which a human tutor does not: it is relatively cost-effective, can be consulted as often as the user requires, does not become tired or critical, and can be turned off when not needed. The two main design problems to be solved are how to design a tutor program which is flexible enough to cater for varying levels of writing expertise and which can easily be customised to suit different contexts. This requires a model of writing which identifies both the commonalities and variables in composing, and acknowledges that writing, like

other forms of human communication, is highly context specific.

## 2. CURRENT APPROACHES

The most flexible writing tutor programs are based on cognitive models of composing [2], as with Rowley & Meyer's "Computer Tutor for Writers"[3], because these identify generalizable composing procedures. However, cognitive models do not clarify how social factors social can - and do - influence composing, which means that programs based on them need to be contextualised during instruction: Rowley & Meyer's CTW is clearly intended to be used within the context of a teaching programme [4]. For a versatile writing tutor program intended for ad hoc use by individual learners as well as within instructional programmes, the fact that composing is socially loaded must be made clear to the user, as a key factor in success in academic writing is the extent to which local academic requirements are met. This is why social approaches to composition, based on sociolinguistic and discourse theories, currently dominate the field of written composition, for example, social constructionism [5][6], critical theory [7] and the multiliteracies approach proposed by Cazden et al [8]. However, theories which view writing as so socially-immersed that generalization about writing processes is not possible do not offer much insight into how to design a versatile writing tutor program.

## 3. SOCIAL MECHANISMS

A proposed solution is to make use of the concept of the social mechanism, in order to arrive at the stochastic algorithms which are thought to generate social processes. In the natural sciences a mechanism is defined as a complex layering of natural forces which are not subject to human control, and which shape events [9]. In the social sciences, however, a mechanism may refer to a system which fulfils a social process via human agency [10] [11] [12]. Franck defines the term "social mechanism" broadly as "the factors which, in combination, generate the phenomena which one wishes to explain"[13]. However, Franck points out the need for identifying a definite *form* in the processes which are considered to be social

mechanisms, and comments that social mechanisms are more than just social processes.

## 4. THE MODELLING APPROACH USED

It is important to note that mechanisms are used in social science to explain not only social trends, but also individual human behaviour [14], which means that composing could be explained by identifying the key mechanisms involved. There are clearly so many complex factors involved in social processes that identifying the mechanisms relevant to composing would seem an impossible task. However, Franck offers a modelling process which helps to focus the search for mechanisms more narrowly: his main contribution is to distinguish between mechanisms and the functions they perform, and, in the process, to clarify the relationship between theory and practice. The modelling process makes use of the principle of reverse engineering in that the modeller needs to work backwards from the real-life manifestation of social processes to work out the underlying functions which are being performed: two models can then be formulated as a result, a practical (empirical) model showing the performance of the functions in real life situations, and a theoretical model, which is a system of functions which need to be performed for the social process to take place. The practical model consists of the mechanisms used to achieve these functions, and, when tested out by observations of real-life social behaviour, in turn validates the underlying theory (i.e. the theoretical model).

## 5. THE COMPOSING ALGORITHM

This is a logical and systematic way of dealing with complex social processes which goes some way beyond rule-of-thumb precepts based on observable events. Written composition, which even researchers into writing processes have described as being too complex and idiosyncratic to categorise, lends itself to this dual-level approach. In a masters research project, working from the observations and subsequent generalisations of teachers and researchers from within the process approach to written composition, I was able to arrive at a practical model of composing which, when communicated to learners, gave them a metacognitive view of writing on which to model their own composing

behaviour [15]. Continuing with the modelling at a deeper level in a doctoral research project, I established that the practical model of composing constituted a mechanism, or a means of effecting a social process, in this case, communication in written mode. It also constituted a type of stochastic algorithm in being a series of recursive stages used to effect a process, with a probable rather than definite outcome. The algorithm was validated when Franck's modelling process revealed it to be informed by a deep-level system of communicative functions (i.e. a theoretical model), rather than merely being a rule-of-thumb maxim based on surface observation. Moreover, the architecture of the system of functions suggested that the social function pervades all other communicative functions, and explains the preoccupation of the critical theorists, social constructionists and New Literacy approaches with the social aspects of composing.

The pre-occupation of such approaches with locating writing within "situated practice" can in fact can be seen to obscure the possible existence of macro-patterning such as the system of communicative functions shown in Fig. 1. Cazden et al acknowledge that one of the problems of immersion in a given socio-cultural context is that it does not lead to a "conscious awareness and control of the inter-systemic relations of a system".

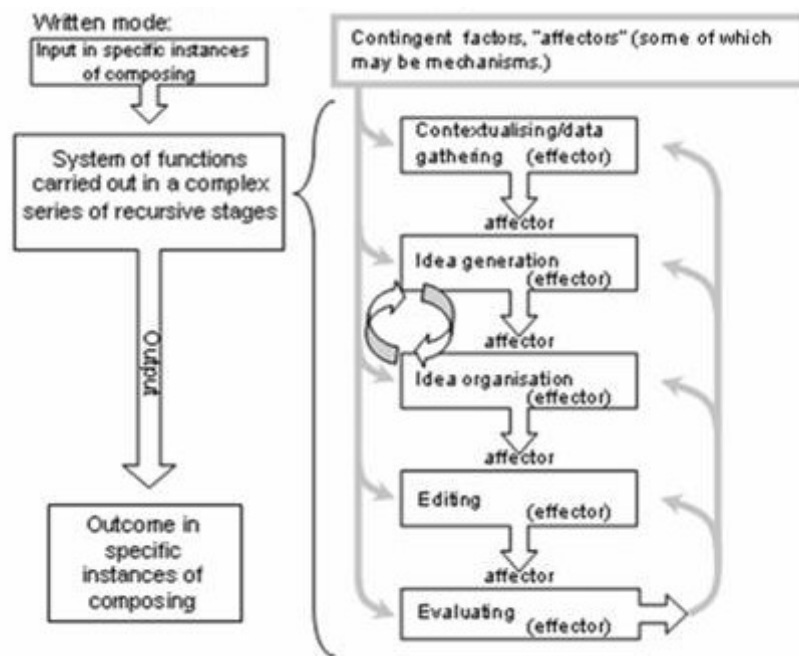
COMMUNICATIVE FUNCTIONS		COMPOSING ALGORITHM	
S O C I A L	Contextual →	1. Prewriting	R E F L E X I V E
	Ideational →	2. Draft writing	
	Interactive →	3. Major editing	
	Social →	4. Minor editing	
	Reflexive →	5. Evaluation	

**Figure 1:** The stochastic algorithm driving composing

The five stages of composing are thought to be a stochastic algorithm which is in effect a social mechanism for carrying out the essential functions needed for effective communication (Fig.1). The writer starts at Stage 1, goes on to Stage 2, and

then comes back any number of times to any stage until the process is complete. The same human agent need not be involved throughout the process: some authors use professional proof-readers or editors to complete the algorithm. It must be noted that the social function in communication is so strong that, while it is most predominant at Stage 4 (correctness is a social, not semantic issue), it permeates all of the other stages (shown in the extreme left of Fig.1). This corresponds with the notion long prevalent in linguistics that social considerations ultimately outweigh the semantic in human interactions. It must also be remembered that a model simplifies social phenomena for the sake of clear explanation, and that the other stages, too, are not neatly separated: there is considerable overlap, but the communicative functions they fulfil are performed predominantly in the successive order given.

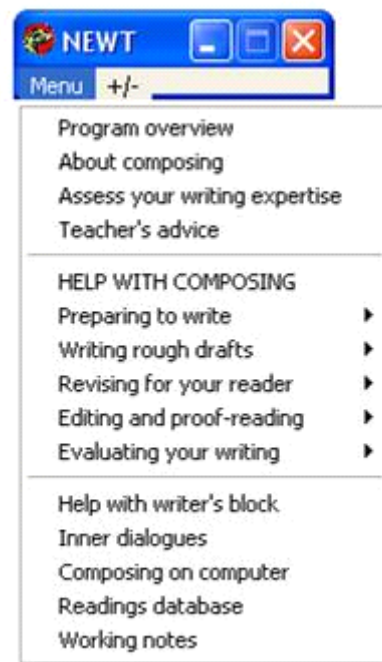
In Fig. 2 a schematic overview is given which attempts to show some of the complexity of composing as revealed in the course of the modelling process. In written mode there is specific input in different instances of composing, for example, a different setting, different interactants, requirements and constraints, and so on. The stages of composing are also affected by contingent factors, some of which in themselves may be social mechanisms or specific features of the context (e.g. sets of institutional evaluation requirements). Each stage in turn *effects* certain of the communicative functions and, in doing so, *affects* all subsequently occurring stages, with the reflexive function acting as feedback loop throughout and not just at the end. There are obviously many more permutations and combinations than it is possible to represent graphically. However, these do not need to be worked out in detail for program design because the identification of the basic algorithm in five stages makes it possible for the user to choose whichever stage is appropriate at any given time during composing: all the designer has to do is ensure that the programmer represents the stages in a form where the user can move rapidly back and forth between stages for instruction, support and advice.



**Figure 2:** The hierarchy of mechanisms involved in written communication

## 6. THE WRITING TUTOR PROGRAM

The template for the writing tutor program design, then, is the five recursive stages of the practical model, which is the core of the program, having been established as the commonalities in composing. The writing tutor program was designed in the form of a help menu on a floating bar which remains superimposed over the MSWord screen but which can be sent to the Start bar when not needed. Further submenus lead off from the five stages, offering help and advice appropriate for each stage. As shown in Fig. 3, other items were included, such as “About composing”, a text lesson describing composing processes, and an automatically-marked test, “Assess your writing expertise”. “Help with writers block” is dealt with as a separate item as well as being linked to each of the five stages, as is an explanation of the “Inner dialogues” which experienced writers engaged in as they compose. “Composing on computer” is a text lesson, and a “Readings database” helps learners to keep track of sources they have referred to in their compositions. “Working notes” prompts users to reflect on their composing (performing the reflexive function) by diarising thoughts and experiences while writing.



**Figure 3:** The writing tutor program main menu

The writing tutor program can be customised to fit local requirements by individual users, who are encouraged to ask their teacher (or mentor) for specific advice relating to each stage of composing and to key this in. This reinforces for the learner writer the idea that the immediate

social context affects the composing process throughout, and not just at Stage 4. Advice is keyed in through the main menu item “Teacher’s advice”, which allows the user to type in and save text which can later be displayed by clicking on “Teacher’s advice on...” sections provided in the submenus leading off the stages. The advantage of having individual users key in the teacher’s advice is that the writing tutor program can be customised to suit not only the level of different grades of learners but the needs of individual learners.

## 7. CONCLUSION

The danger of testing out educational software to demonstrate its effectiveness is that *any* intense focus on composing is likely to be beneficial, no matter what model of composing is used, particularly in the case of a writing tutor program, as students tend to enjoy using computer-mediated applications. It is therefore difficult to separate the enthusiasm and resultant improvement in performance from the actual efficacy of the application used. Moreover, my experience with using the algorithm of five stages previous to its translation into a prototype program was that learners tended to take from the system what they needed. The more creative and proficient learner writers tended to make small ad hoc adjustments to their composing behaviour; weaker writers, on the other hand, tended to adopt the system wholesale. One student, previously considered dyslexic, even managed to use it to improve her comprehension performance, because she had intuitively grasped the fact that the algorithm involved a communicative process which could be extended to forms of communication other than composition. The writing tutor program undoubtedly needs to be tested out, but, as its proposed application is very wide, it is possibly best to focus on diverse uses in individual case studies, rather than testing it out on whole groups. To offset the “Hawthorne effect” in trying out a novel application, learners might need to be given a choice between using the writing tutor prototype and another such application, to see whether identifying social mechanisms really does in fact lead to more effective educational software design.

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