



## A computational narrative construction method with applications in organizational learning of social service organizations

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### ABSTRACT

Acquisition of knowledge must be interwoven with the process of applying it. However, traditional training methods which provide abstract knowledge have shown ineffective for gaining experience of the work. In order to solve this problem, more and more researchers have included narrative in simulation, which is known as narrative simulation. By providing the narratives, participants recognize the choices, decisions, and experience that lead to the consequences of those decisions. It has been proven that narrative simulation is very useful in facilitating in-depth learning and reflective learning. However, conventional methods of data collection and narrative construction for narrative simulation are labor intensive and time consuming. They make use of previous narratives manually and directly. They are inadequate to cope with the fast moving world where knowledge is changing rapidly. In order to provide a way for facilitating the construction of narrative simulation, a novel computational narrative construction method is proposed. By incorporating technologies of knowledge-based system (KBS), computational linguistics, and artificial intelligence (AI), the proposed method provides an efficient and effective way for collecting narratives and automating the construction of narratives. The method converts the unstructured narratives into a structural representation for abstraction and facilitating computing processing. Moreover, it constructs the narratives that combine multiple narratives into a single narrative by applying a forecasting algorithm. The proposed method was successfully implemented in early intervention in mental health care of a social service company in Hong Kong since the case records in that process have structural similarities to narrative. The accuracies of data conversion and predictive function were measured based on recall and precision and encouraging results were obtained. High recall and precision are achieved in the data conversion function, and high recall for the predictive function when new concepts are excluded. The results show that it is possible for converting multiple narratives into a single narrative automatically. Based on the approach, it helps to stimulate knowledge workers to explore new problem solving methods so as to increase the quality of their solutions.

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### 1. Introduction

Mental health problems impact seriously to the society. The impact of mental disorders can be reduced by identifying the distress at an early stage, establishing an early and accurate diagnosis and providing prompt and effective treatment. This idea underlies the interest in early intervention in mental disorders. Some countries have put this as a major element in their mental health policy (Kemp, 1993). Evidence from many evaluation studies suggests that well-designed and intensive early intervention programs have the potential to yield outcomes that benefit health plans (e.g., improved health outcomes, lower health care costs, lower maternity costs, fewer emergency room visits) and the outcomes that have potential

benefits for Medicaid, the government, and society as a whole such as higher educational attainment, greater economic self-sufficiency, lower crime rate, etc. (Perloff, Butler, Berry, & Budetti, 1998).

However, there is a variety of challenges faced by the mental health social service providers (Ferns, 1995). The increased need for services, decreased subvention for services due to the economic restructuring and the attendant quest for budget cuts, and growing government regulation lead to the formulation of an immense pressure to social service organization to provide effective, customized and high-quality care at the lowest cost and greater administrative control (Savage, 1987). The social service providers are facing the problem of conflict between these objectives. Limited resources must be traded off in order to accomplish any one of the objectives over the others. Shrinking revenues have forced the social service providers to look for creative ways to provide quality services at less expense.

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As a result, any techniques or methods that sustain knowledge growth and distribution are keys to quality services (Von Krogh & Grand, 1999). The most typical way of learning is providing training for the workers. In the traditional model of on-the-job training, workers would typically receive a pre-prepared course in the new regulations, procedures, or processes to promote the new practices. They are often at a different location from their place of work and they are expected to apply this abstracted knowledge later in their workplace. As indicated by the figures of training effectiveness, the results are often observed not to be encouraging. Businesses spend up to USD\$100 billion per year to train up workers. Yet estimates are that less than 10% of this training transfers to the job (Detterman, 1993). Norman (2000, 2003) also presents a very interesting discussion of full-curriculum interventions versus small-scale laboratory studies and concludes that curriculum-wide studies are not worth the effort involved in doing them.

Current theories of learning reveal that the knowledge acquisition process cannot be separated from the process of applying it. The effective integration of working and learning is a fundamental requirement for businesses to remain competitive. Brown and Duguid (1991) also argue that learning is the essential bridge between working and innovation, and the three processes are inextricably intertwined. They argue that on-the-job training separates simplified abstract principles from the rich detail of actual practice and separates learners from the workplace community. Instead, they advocate that technology and business processes should support the existing rich learning practices within the workplace community by enabling individuals within communities to somehow retain and share their experience. This influential article has inspired many projects in knowledge management (KM) and organizational learning (OL). Hence, the approach of acquisition and sharing existing experience is the key goal of many OL approaches (Landes, Schneider, & Houdek, 1998).

Numerous learning systems have been developed for the retention of information and knowledge of organizational problems. Some of them are dedicated software tools intended to offer a virtual educational and/or online training environment. They provide dynamic capabilities to acquire and share the knowledge within an organization so that the knowledge workers can learn and cope with their work effectively. Despite a large number of functions covering a large number of users' needs, the traditional methodologies of learning systems are fundamentally limited. These tools provide past information or cases for training and decision support, which is insufficient to cope with the complex, diverse and continuously evolving business environment. Such kind of systems may hinder innovation by providing previous experience for problem solving.

Recently, more and more researchers have incorporated narrative into learning. Such kind of manual simulation practice is named narrative simulation. It is interesting to note that narrative simulation is very useful in facilitating in-depth learning and reflective learning (Cole, 1997). According to Argyris (1977), reflective learning is the core of organizational learning. Reflection can be seen as "consciously thinking about and analyzing what one has done (or is doing)". Reflective Learning is a structural approach that enables learners to reflect upon their learning, to understand their own learning processes and thus allow them to become more autonomous. However, traditional narrative simulation makes use of previous narratives manually and directly which is inadequate to cope with the fast moving world where knowledge within organizations is changing rapidly and continuously updating is vital.

Since the case records in early intervention in mental health care have structural similarities to narrative, a computational narrative construction approach is proposed in this paper for providing a reflective training of early intervention in mental health care. The proposed approach aims at collecting the narratives

and constructing a scenario by combining the collected narratives automatically. It integrates the technologies of knowledge-based system (KBS), natural language processing (NLP), artificial intelligence (AI) and computational forecasting method. Based on the approach, it provides extra time for the knowledge workers for exploring new problem solving methods so as to increase the quality of their solutions. A series of experiments based on real cases have been carried out for measuring the accuracy of data conversion and the accuracy of narrative prediction.

## 2. Related work

Narrative simulation is frequently employed in instruction aimed at accident prevention, farm safety, and solving work place problems. It starts from defining the topic of simulation. Based on the selected topics, stories are collected through interviews, focus group, participant observations, etc. It is arguable whether any plausibility story or an actual story should be used. Some research work suggests that it would be more powerful to use to an actual contemporary story to support reflection and change (Bliss & Mazur, 1996; Phillips, 1994) while some other researchers suggest that verisimilitude or plausibility is sufficient in narrative (Bruner, 1990; Phillips, 1994). The stories collection process is not only time consuming, labor intensive but also heavily relied on the experience of the story teller. In this paper, a novel computational method of generation of narratives is proposed to overcome the challenge and address the deficiency in story collection and construction.

Computer-based text generation has been an area of interest for many researchers. Early systems included interactive story segments where the system would produce part of the story and then wait for user interaction before producing more of the stories such as ZORK (Infocom, 1979). Some systems include initial conditions or story grammars could be changed in order to produce brand new stories such as TALE-SPIN (Meehan, 1977) and UNIVERSE (Lebowitz, 1985). TALE-SPIN was a program that produced stories by setting goals for characters and then recording their attempts to reach the goal. It demonstrated how computer techniques in problem solving can be applied to storytelling. They were successful in showing the ability of computers to generate very short coherent stories. However, they were only able to generate a limited range of stories within a rigid pre-defined structure of the stories. Some researchers have employed story grammars to produce automatic storytellers such as GESTER (Pemberton, 1989) and JOSEPH (Lang, 1997). Story grammars were developed with the objective of creating a theory of story understanding. They represent stories as linguistic objects which have a constituent structure that can be represented by a grammar (e.g. Lakoff, 1972; Mandler & Johnson, 1977; Rumelhart, 1975). However, such kind of systems was only able to produce stories that satisfy its grammar and is not able to modify its knowledge to generate different outcomes. Current systems such as BRUTUS (Bringsjord & Ferrucci, 2000) are hybrid systems which consist of merging different known methodologies into one program.

Most of the previous research works appear to consist of predefined conditions, predefined goals, and inferred post-conditions. The resulted narratives are hence rigid and lack of diversification. The top-to-bottom approach requires large amount of workload for constructing and maintaining the predefined elements. In this paper, the authors attempt to develop a bottom-up and semi-automatic approach for the collection of narratives which helps to save the time and reduce the cost for maintaining the knowledge update. Furthermore, the model makes use of a computational forecasting method, which automatically constructs the scenarios based on multiple narrative resources, in order to prevent the simple and direct usage of previous narratives.

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