Instructional Design:
A Perspective Based on Cognitive and Constructivist Approaches

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Abstract
The main aim of the present paper is to outline a theoretical framework of instruction based on the elements of two major approaches of cognitivism and constructivism. To begin with, the paper introduces the notion of instructional design and discusses the importance of psychology of learning and instruction in designing instructional models. Further, the paper identifies the prototypical schema theory and cognitive apprenticeship as representing the important elements of cognitive and constructivist approaches. The paper discusses cognitive apprenticeship and a prototypical schema theory and then attempts to outline an instructional model based on an integration of these two approaches. It is emphasized that the integrated approach can address some of the problems that cannot be dealt with by any of the two constituent approaches individually. The proposed integrated model attempts to identify strategies that may be used for schema building through cognitive apprenticeship. The integrated approach provides a theoretical basis for error-reduction in the learning process.

Keywords: Instructional design, cognitivism, constructivism, schema theory, cognitive apprenticeship, integrated approach

Introduction
Psychologists have always been concerned with the cognitive foundations of learning and instruction. Cognitive learning theories have contributed significantly to understanding the issues in psychology of learning and instruction. In recent times, constructivist principles have also impacted the understanding of the processes of learning and instruction significantly. However, cognitivism and constructivism have both provided key inputs in instructional design and educational technology. The behavioural, cognitive and constructivist learning approaches have been the mainstay of the technology of instructional design. Different combinations of these approaches have provided the basic guidelines to instructors, researchers and policy makers interested in designing models of instruction that would enhance learning at different levels. The relationship between instructional design and the psychological theories of learning has long been explored in domains such as classroom teaching, online instruction and web-based distance education (Boulton, 2002 [6]; Bruce, Peyton & Batson, 1993 [8]; Clancey, 1997 [10]; Conway, 1997 [11]; Gagne, 1965 [13]; Mergel, 1998 [17]).

Instructional Design
The importance of instructional design in the process of learning and teaching has been discussed below. As noted by Kasowitz (1999) [15]:

Instructional design (ID) is the systematic process of planning events to facilitate learning. The ID process encompasses a set of interdependent phases including analysis of learners, contexts and goals; design of objectives, strategies and assessment tools; production of instructional materials; and evaluation of learner performance and overall instructional design effort (Gagne, Briggs, and Wager, 1992). (¶ 1)
In addition to the traditional face-to-face classroom teaching, instructional design is important in different instructional contexts and domains. The practice of instructional design is important in contexts such as web-based distance education, computer-assisted individualized learning, creating expert and advisory systems and information management systems. Instructional design can be conceptualized as having two major steps: Designing the instructional process and formulating a courseware that fits within the conceptualized process. Taking into consideration both, cognitive and constructivist positions these two steps should entail the following elements: Knowledge acquisition and abstraction; effective sense-making by learners; encoding, storage and retrieval of information related to the relevant domain; provision of problem-solving templates along with building up a flexible knowledge base that encompasses real world problem solving; learner-centered teaching strategies; student autonomy; cognitive exploration and discovery; feedback from students and fruitful social interaction among learners, peers and teachers.

In order to incorporate the above elements in an instructional design it is important to emphasize both, cognitive and social aspects of learning. The cognitive element in the proposed instructional design would aim at providing a clear direction whereas the social element would mainly provide opportunity for feedback, interaction and autonomy to students. The proposed instructional approach would therefore focus both on ‘directed learning’ and ‘student autonomy’. One way of directing learning is to provide clear objectives and explanations regarding organization of the courseware. This prevents the students from getting disoriented and overwhelmed by the course objectives and course content (Oliver, Herrington & Omari, 1996: As noted in ‘Instructional design tips’, 1998 [5]). The same document notes the following regarding direction and student autonomy in the online learning process:

This does not mean that each step and learning activity be spelled out for the student. While this may be appropriate for some content-based exercises, advanced concept integration is better served when students are gently directed to a goal (p.2).

At the outset the two concepts of ‘directed learning’ and ‘student autonomy’ appear to be inconsistent with each other and depicting different instructional philosophies and practices. However, the integrated instructional approach presented later in this paper attempts to provide a harmonious link up of the two within a cognitive-constructivist pedagogical paradigm. The cognitive-constructivist pedagogical paradigm can function best in a constructivist-learning environment. In such an environment the cognitive processes implicated in knowledge construction have to be directed via real world learning opportunities and teacher-student interaction. As noted by Boulton (2002) [6]:

Katy Campbell (1999) highlights three main principles of constructivism from a design point of view, which are: 1. Instruction be concerned with the experience, convictions and constructs that learners already posses. 2. Instruction be structured so that it can be easily understood and modified by the learner. 3. Instruction be designed to facilitate exploration, extrapolation, and elaboration (p. 3).

It is important to note at this point that cognitive and constructivist perspectives are not antithetical to each other. They focus on active cognitive processing and information use and interactive learning respectively, but cognitive learning theories do not rule out social factors whereas constructivist practice does not rule out cognition. In fact, constructivist perspective entails meta-cognition. The two perspectives simply focus on two major components of learning and therefore it is imperative that any instructional design should incorporate the elements of both the perspectives. As noted by Parsons, Hinson and Sardo-Brown (2001) [18]: “From the constructivist perspective, learners try to make sense of the world by relying on their pre-existing schemas. Learning is aided by social interaction with peers and teachers and via world experiences” (p.432). The following sections of the paper discuss the cognitive and constructivist perspectives to learning and then narrow down these perspectives to two specific approaches: The prototypical schema theory (Alba & Hasher, 1983 [1]) within the cognitive perspective and cognitive apprenticeship approach (Collins, Brown and Newman, 1989: As noted by Chee, 1995 [9]) within the constructivist perspective. It is important to note at this juncture that schema theory has both cognitive and constructivist elements, but is more cognitive in emphasis whereas, cognitive apprenticeship is metacognitive as well as social and collaborative in nature. Overall, both schema theory and cognitive apprenticeship have cognitive elements and are concerned with knowledge construction. The paper
discusses these two approaches and then attempts to outline an instructional model based on an integration of these two approaches and active learning.

**Active Learning**

The proposed instructional model is based on active learning approach and opposed to passive and hierarchical approaches. Both, schema-based learning as well as cognitive apprenticeship are active learning views. Both these views are different from traditional instructional approaches. The traditional learning approach consistent with behaviouristic philosophy is characterized by following general features:

(a) Learning environment is completely controlled by the teacher, (b) involves passive and mechanical learning, (c) fact learning and abstract symbol manipulation is emphasized, (d) emphasizes one-way transmission of knowledge: from teacher to students, and (e) teacher is in a position of authority and decides the topics, concepts and skills to be taught and teaches them directly.

**The cognitive perspective of learning and instruction**

The cognitive perspective of learning and instruction sees learners as active information processors. This active view of learning is opposed to the behaviouristic passive view of learning. Parsons, Hinson and Sardo-Brown (2001) [18] have outlined the major features of cognitive learning as follows:

1. The cognitive perspective of learning has its roots in Gestalt psychology. Gestalt psychologists generally believed that our perceptions are active and subjective. Learning and problem solving occurs when we actively restructure information. Such restructuring is based on prior learning and current states. Gestalt principles of perceptual organization provide important inputs for course design and organization.

2. In the last 40 years or so the cognitive perspective has almost become synonymous with the information-processing model of learning. This model uses the computer metaphor to understand information processing through the sequential stages of encoding, storage and retrieval. This model emphasizes the role of selective information processing and its influence on memory, and subsequently on learning. Human beings develop cognitive structures and these structures determine what is filtered and selectively perceived. This in turn influences memory and learning. Gagne (1985) [14] has extended the information-processing model to specify the phases of learning and instruction.

3. In recent years active learning has been associated to and understood in terms of dual coding theory, cognitive behaviour modification, schema theory and cognitive structuralism.

4. Schema theory and cognitive structuralism form the basis of the contemporary cognitive learning paradigm. Schemas are cognitive structures that form the fundamental units of information processing. Cognitive structuralism emphasizes the use of appropriate schemas as most crucial to teaching and learning (Leinhardt, 1992) and that schemas facilitate the functions of learning such as: categorizing, remembering, comprehension, and problem solving (Byrnes, 1996) [As noted in Parsons et al., 2001].

5. Cognitive structuralists such as Bruner and Ausubel have outlined ways in which cognitive structures or schemas might be utilized in classroom instruction. Bruner emphasized the role of motivation in learning and linking new information to existing knowledge structures in a learner-centered manner. Thus, Bruner stressed upon discovery learning and subjective linkages formed by students. According to Bruner, “Left to process information on their own, learners will organize the information for encoding, storage and retrieval in the most personally efficient, expedient, and comfortable way possible.” (Parsons et al., 2001, p.278). On the other hand, Ausubel (1968) [3] emphasized selective linkages as opposed to subjective linkages. Ausubel and others “believe that we learn more efficiently and effectively when we are exposed to or receive a structure for the organization of information rather than generate our own” (Parsons et al., 2001, p.278).

Bruner favoured student autonomy whereas Ausubel favoured direction by teacher. Both however provided perspectives that were in line with cognitive structuring and linking prior knowledge with new
knowledge. The role of schemas in formation of such linkages has long been recognized. The present paper employs a prototypical schema theory (Alba & Hasher, 1983 [1]) as a constituent part of instructional design. The following section will discuss the relevant features of this theory.

A prototypical schema theory

Before discussing the theory in question, it is important to note what a schema is. There is no single accepted definition of schema but most schema theorists (Ausubel, 1960 [2]; Bartlett, 1932 [4]; Bransford & Johnson, 1972 [7]; Dooling & Lachman, 1971[12]; Marshall, 1995[16]; Royer & Cable, 1975[19]; Taylor & Crocker, 1981[20]; Thorndyke, 1977[21]) characterize a schema as follows: A schema consists of the general knowledge a person possesses about a particular domain; it allows for encoding, storage and retrieval of information related to that domain; it enables gap filling in the information available and also going beyond the given information; it consists of the structure against which new incoming information and experience is mapped; it directs encoding and retrieval from memory; it influences efficiency and speed of information processing; it provides structure for learning and solving problems; facilitates evaluation of experience, anticipation of future, planning and execution of goals. In the light of these functions of schemas Alba and Hasher (1983) [1] have outlined a theory of memory. Their theory has not been proposed to understand instruction and learning. However, it explains the schema based processing and memory functioning and can thus be extended to explain schema based view of learning and instruction.

Alba and Hasher primarily discuss the four central encoding processes of selection, abstraction, interpretation and integration along with the central retrieval process of reconstruction. Each of these will be discussed very briefly in the following section:

Selection: This process selects only some of the incoming information for further processing. Information selection is done on the basis of relevant prior knowledge, its activation and importance of incoming information with respect to the relevant activated schema. Because of this process people may encode incomplete information and then later cannot recall the exact information.

Abstraction: This process codes information with reference to meaning and not the exact format. Semantic aspects are stored at the expense of lexical and syntactic aspects. Information is thus further reduced. Information deficit occurs due to selection and abstraction. This deficit is compensated by gap filling during recall. Such a reconstruction may further result in memory errors.

Interpretation: This process generates relevant prior knowledge for the purpose of comprehension. This results in inference making. Interpretations are thus based on the perceiver’s activated knowledge. Distortion of to be encoded information occurs because the inferences and interpretations are encoded instead of encoding of explicitly presented information. Constructive errors of addition and elaboration may occur at this stage.

Integration: This process enables the formation of a knowledge consistent and holistic representation from the products of the processes of selection, abstraction and interpretation. It also changes the old information in the light of new information. Retrieval may thus be inaccurate because memory traces for to be remembered information do not exist.

Implications for instructional design

The schema theory discussed above has several implications for instructional design:

1. Schema based cognitive activity is assumed to be automatic in nature. In an instructional context this means that students will automatically engage in schema based processing and will interpret new information in the light of activated prior information.

2. Prior knowledge influences sense making and comprehension significantly. Therefore, any instructional design should have implicit checks of prior information.

3. Schema based cognitive processing is bound to result in reduction and some distortion of explicitly presented material. It is important therefore that instruction should be designed in a way so that nature and type of errors at each stage of encoding are identified and dealt with.
4. The issue of teacher directed external monitoring appears to be as important as self-monitoring by learners.

5. Sources of errors and methods of active error-identification and error-reduction may be well articulated on the basis of an understanding of the central encoding processes. Both instructors and learners have to be active participants in this process.

6. Instructional design should be sequenced, organized and explicated well.

7. The problem of explication of the learning and error-reduction processes cannot be dealt solely by the schema based perspective. This brings to fore the importance of methods and models of execution of processes and hence cognitive apprenticeship and constructivism comes in picture.

The next section will discuss the general features of constructivism followed by a brief discussion of the cognitive apprenticeship approach.

The constructivist perspective of learning and instruction

Constructivist perspective is a cognitive framework that goes beyond the traditional cognitive framework of information processing. Constructivism offers a learner centered perspective. As far as acquisition of schemas is concerned, constructivism offers a perspective that takes into account both nativism and empiricism. Nativism emphasizes that knowledge acquisition is primarily an individualistic process and that we are innately pre-disposed to understand the complexity around us. Whereas, empiricists believe that the presence of others (instructors and peers in the instructional context) is of foremost importance to knowledge construction. A possible reconciliation of the two opposing approaches can be found in constructivism. Constructivists do not believe in any inborn tendency but agree that people impose their own knowledge structures or schemas on the world and that our experiences and interaction with others are important in learning (Parsons et.al., 2001[18]). Theoretical parallels can be drawn between constructivists and cognitive theorists such as Piaget, Vygotsky and Bruner. As noted by Parsons et al., “From the constructivist perspective, learners try to make sense of the world by relying on their pre-existing schemas. Learning is aided by social interaction with peers and teachers and via real world experiences” (p.432). In addition to this, constructivist instructional practices emphasize the following features in any instructional set-up:

Student autonomy: Students are made responsible and accountable for their learning. Their interest, potential and feedback is taken into consideration.

Social Interaction: The classroom is treated like a community of learners. Interaction is encouraged between teacher and students and also among students. Interaction forms a major part of the learning opportunity.

Development of meta-cognitive skills: Higher order thinking skills are emphasized in constructivist thinking. Students are encouraged to explore and reconstruct their own thinking.

Cognitive exploration: Meta-cognitive skills are developed by providing ample opportunity for cognitive exploration. Such an exploration entails direct real world experience. Teachers are mediators of such experience.

Guided discovery: Learner-centered instruction is emphasized. Teachers serve as guides and students are encouraged to use their own strategies. The interests and motivations of learners are considered important in learning.

The present paper focuses on cognitive apprenticeship as the constructivist approach that can be successfully integrated with the prototypical schema theory to provide a workable approach to instructional design.

Cognitive apprenticeship

Chee (1995) [9] has noted that according to Collins, Brown and Newman (1989) cognitive apprenticeship has two major characteristics. Firstly, it involves teaching of methods that are used by experts. Processes are explicated and exemplified in real world domains. This exemplification results in a better understanding of the relationship between concepts and facts. Second, it aims to develop cognitive and meta-cognitive
skills. “This focus requires supporting the externalization of processes that are carried out internally (that is, mentally) and hence are not readily observable. Cognitive apprenticeship teaching methods bring tacit processes out into the open so that they can be observed. In addition, it seeks to encourage the development of self-correcting and self-monitoring skills through the technique of reflection and engagement in generative-evaluative cycles of learning activity” (Chee, 1995, p.137).

The present section on cognitive apprenticeship approach (Collins et al., 1989) is based on the description of this approach provided by Chee (1995). Collins et al proposed six teaching methods within the cognitive apprenticeship approach: Modeling, coaching, scaffolding, articulation, reflection, and exploration. Modeling, coaching and scaffolding are useful in providing higher mental skills and entail training supported by the instructor. Articulation and reflection focus the attention of students on expert problem solving and help students in developing their own strategies. Learner autonomy and self-regulation are encouraged through exploration. A brief discussion of all these methods is provided below:

**Modeling:** This method entails observation of expert performance by students for building a conceptual model of the processes important for task at hand. Internal cognitive processes are externalized so that students can observe and practice the necessary skills.

**Coaching:** This method aims at making learning meaningful by providing opportunity for real world problem solving. Sub-skills and conceptual knowledge are actively applied to the problem domain. Knowledge is grounded in experience to make it flexible and not bound to textbooks. “Coaching is made effective by means of highly interactive and situated feedback. The content of coaching is related to specific problems that students face while carrying out a task” (Chee, 1995, p.138).

**Scaffolding:** Expert assists students in practice. Students participate according to their potential and the responsibility they are capable of. Through scaffolding independence in learning is introduced and self-monitoring and self-correction is fostered. Scaffolding is coupled with fading. Through the process of fading the expert gradually removes his control and students learn the meta-cognitive skills characteristic of expert performance.

**Articulation:** Students are encouraged by the experts to explicate their problem solving. This helps in refinement and reorganization of reasoning strategies and generation and evaluation of knowledge. This in turn enables the students to assimilate and internalize the concepts in an effective manner.

**Reflection:** Students are encouraged to compare their problem solving skills and processes to that of experts’, with peers, and with an abstract cognitive model of expert performance in that domain. Students identify their problems and difficulties and adjust their performance to bring it closer to expert performance.

**Exploration:** Students are urged to engage in independent thinking by experts. They try to set their own goals and identify their own interests and motivations. They also learn to ask questions and identify problems on their own.

**Implications for instructional design**

1. The schema-based approach takes into account cognitive processes and structures in the learning process. It therefore helps in understanding the learning process from a cognitive perspective but it does not provide explicit ways and methods of enhancing learning. Such methods are provided by cognitive apprenticeship.

2. The cognitive schema theory emphasizes cognition in the learning process and provides a sound basis for effective memory functioning. However, it does not say anything about the social context of instruction in which schema building and knowledge acquisition takes place. Cognitive apprenticeship provides ways of shaping cognitions via explicit and interactive methods. In this perspective learning is grounded both in cognitive and social reality. Vygotsky’s thought regarding socio-cultural origins of higher order cognitive functions has clearly influenced the cognitive apprenticeship view (Chee, 1995).

3. Cognitive apprenticeship is consistent with the situated cognition paradigm. To quote Chee, 1995:
Situated cognition places a strong emphasis on how representations are created and given meaning (Clancey & Roschelle, 1991). There is a bias in favour of addressing the difficult issue of human understanding as opposed to simply knowing....understanding is viewed in terms of appropriation and meaning negotiation (Pea, 1992a) and entails engaging in sense-making activity (Carroll, 1990; Chee et al, 1993) (p.138).

Cognitive apprenticeship thus provides an opportunity to view schema-building processes explicitly within an interactive instructional environment.

An integrated perspective of instructional design

The instructional design that is outlined in the remaining part of this paper attempts to integrate the externalization of mental activity as outlined in the cognitive apprenticeship perspective with central encoding processes of the prototypical schema theory. The integration of these two approaches and the ensuing method of designing instruction are based on some assumptions. It should be noted at this point that these assumptions are not arbitrary and are more like key features of the integrated view. These assumptions are based on the evidences that exist in favour of both the constituent views. These assumptions are given below:

1. All the encoding processes of schema theory facilitate learning and memory of schema consistent information. However, it is important to direct these processes so as to reduce errors due to the automatic operation of these processes.
2. Distortions of memory and information reduction would take place due to the natural schema based comprehension resulting from the processes of selection, abstraction, interpretation and integration. These four processes therefore need to be directed by the expert. Learners should be made aware of the kind of errors that may occur due to automatic schema based processing.
3. Awareness and identification of errors and underlying encoding processes that provide the basis for knowledge construction can be achieved by employing the methods of cognitive apprenticeship.
4. Learners will implicate their prior knowledge structures automatically in any instructional context. Therefore, the proposed instructional method articulates the need to have built-in checks for type and relevance of prior knowledge for each encoding process.
5. Built-in checks for prior knowledge at each step would provide important inputs for designing, organizing or modifying course contents and instructional strategies. This would also provide an opportunity to the instructor for self-regulation of his/her own strategy.
6. Articulation of the complex interrelationships between type of encoding process, memory error involved and corrective measures needs to be done at each stage of instruction.
7. Emphasis should be there on cognitive exploration through articulation and reflection at each step of instruction in order to facilitate the above-mentioned features.
8. Overall, schema building can be enhanced and central encoding processes can be monitored and directed through cognitive apprenticeship methods and these methods can be used to reduce errors that automatically arise due to central encoding processes.

The following section outlines the proposed steps of the integrated instructional perspective. Each step signifies a central encoding process postulated by Alba and Hasher, 1983 [1] in combination with methods of cognitive apprenticeship proposed by Collins et al., 1989 (as noted by Chee, 1995[9]). The proposed approach generally aims at: (a) Externalization of each central encoding process so that the learners can make sense of their schema building experiences and also understand the ways in which errors might creep in their interpretations due to cognitive processes, (b) explicating ways through which errors may be reduced and, (c) embedding of relevant apprenticeship methods within each step of instruction. Externalization and expliciation of central encoding processes can be done by selecting the appropriate cognitive apprenticeship methods from the ones proposed by Collins et al., 1989. The steps of the proposed approach have been described below:
Checks for prior knowledge: Since the material presented by the instructor will always be encoded in the light of pre-existing knowledge, the first step should be to check the extent and depth of relevant prior knowledge of students. It is also possible that students do not have any relevant prior knowledge in that domain. Therefore, the first step of instruction should be to check the nature, type, extent, existence/non-existence of domain related knowledge. During instruction such knowledge will get activated and influence the processing and understanding of new information. The following aspects need to be emphasized at this stage: (a) Encouraging articulation by students regarding interests and domain specific self-knowledge, (b) designing of class-tasks by the instructor for ascertaining the level and content of prior knowledge, (c) designing, modifying and organizing course content and instructional strategies in the light of inputs received from students.

The above steps would help in providing a firm base for instruction and enhance students’ motivation, autonomy, interest, participation and active learning. These steps would also serve as a stepping-stone to self-correction and realistic evaluation of course-content, course-organization, and instructional strategy by instructors.

Controlled selection: At this step it is proposed that strategies be adopted to ensure a controlled encoding process rather than an automatic one. This strategy is important in utilizing the existing knowledge base of the learners and establishing a base line from where the instruction can take off in the desired direction. Controlled selection of relevant schema knowledge can be achieved by explicitly stating appropriate linkages between prior concepts and the task at hand. Problems and real world scenarios can be designed by the instructors/experts for explicitly demonstrating the importance of linkages. Tacit connections should be clearly stated. Emphasis should be on how to use prior concepts effectively. Controlled selection would help in providing a basis for further relational processing. At this stage a combination of direct information transmission as well as modeling by experts can be employed. Learners should be encouraged to articulate their understanding.

Directed abstraction: Abstraction automatically codes incoming information with reference to meaning and not the exact format. Semantic aspects are encoded but a lot of information is missed out. Abstraction directed by experts can therefore deal with the problems that may occur due to default schema activation and assignment. The methods of modeling, coaching, articulation and reflection can be used to provide direction to the process of abstraction. Learners should be given an opportunity to observe experts engage in authentic problem solving. Students can thus form an appropriate conceptual model. Through directed abstraction appropriate coding of meaning would occur and the problem of meaning reduction can be dealt with to a large extent. At this stage students should be allowed to engage in active problem solving with constant feedback from experts. Students should also articulate their knowledge and engage in active reflection after feedback. Abstraction thus takes place via expert monitoring.

Interpretation and assimilation: Understanding and increment in current knowledge occurs when abstracted knowledge is further elaborated; inferences are made and then assimilated with the existing knowledge base to form coherent representations. These are pure cognitive and tacit operations that would occur naturally in any instructional set-up. However, it is proposed that these operations can be explicated by experts/instructors so that meaningful, complete and desired representations be formed and the course contents get assimilated in a desired way. To begin with, de-briefing regarding the earlier processes should be done at this stage. This would provide the learners with a basis for self-evaluation and self-regulation. Following steps can be followed to enhance interpretation and assimilation:

1. De-briefing by experts in the form of short recapitulation of the conceptual model required for further interpretation and comprehension.
2. Identification of ways to deal with constructive errors and errors of inference. One way would be to emphasize and reiterate relevant schemas and de-emphasize problem solving strategies that may lead to errors.
3. Providing a problem-solving environment where students are engaged in active problem solving through integrating sub-skills and linking conceptual knowledge to real world problems meaningfully.
4. Enabling students to respond to feedback by experts.
5. Utilizing the apprenticeship methods of coaching, articulation and reflection to enhance understanding. Providing an environment for active performance of learners. Overall performance is active but monitored by the expert.

6. Encouraging students to articulate goals and reflect on the level of their learning.

7. Comparing the evaluation done by experts and self-evaluation of students. The expert at this stage should find ways to fill the gaps between the two evaluations by providing appropriate feedback and devising ways so that students can respond to feedback.

**Scaffolding, fading and exploration**: These methods should be used in the manner as conceptualized by Collins et al. Once an integrated knowledge base is formed learners should be directed to become independent performers through the methods of scaffolding, fading and exploration. These should be employed to assist learners in complex task performance, provide detailed feedback and gradual removal of monitoring and support by the expert. Learners at this stage should be able to identify personal goals and learn independently.

The theoretical model proposed above offers an approach where learners are provided an opportunity to view and control their schema-building processes explicitly within an interactive instructional environment. The methods of cognitive apprenticeship approach provide this opportunity. Instruction can therefore be designed keeping following points in mind:

1. Built in checks of prior knowledge should be designed at each stage. Such checks should be coupled with de-briefing by experts.

2. Models of various instruction related tasks can be designed in such a way so that methods of reducing errors during schema based encoding are clearly explicaited and exemplified by experts.

3. Nature of possible memory distortions and role of experts in dealing with them should be kept in mind in the design of course structure, within lesson sequencing, content reviews and planning cognitive strategy activators.

4. Models of instruction related tasks should aim at gradually enhancing learner control.

5. A proper combination of instructor directed learning and student autonomy should be achieved at each stage of schema building experience. This can be done by instructor directed use of appropriate cognitive strategies that enhance schema based processing in such a way that errors due to automatic cognitive operations and default use of prior knowledge can be controlled through explication and exemplification by experts. Embedded within this should be articulation, reflection and self-evaluation by students.

**Conclusion**

It can thus be concluded that the proposed approach is based on learning through negotiation of meaning. The meaning negotiation takes place in the form of teaching learners to participate in their own cognitive experience and learning to tackle their own errors. The learners thus learn to monitor their own learning and negotiate meaning through active awareness of possible errors. Learners also learn to form proper linkages between conceptual and real world knowledge and linkages between prior and incoming information. Such linkages provide a firm basis for acquisition of appropriate meaning and concepts that eventually help in active problem solving. The proposed method of designing instruction is meta-cognitive in nature because it proposes to create awareness among learners of their own cognitive processing. Teachers and learners are active and responsible participants in the learning method proposed because eventually learners become independent monitoring agents of their own cognitive changes due to learning with the active help of experts.
References
