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The TIP Theory: Prescriptions for Designing Instruction for Teams

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ABSTRACT

The purpose of the Team Instructional Prescriptions (TIP) theory is to prescribe a set of systematically integrated principles for designing instruction for teams. The structure of the theory is based on Reigeluth and Merrill's conditions-methods-outcomes framework. The TIP theory identifies two interrelated instructional outcomes: effective, efficient teamwork, and effective, efficient team task performance. These outcomes can be attained by prescribing concurrent instructional methods for both team development and task performance. The selection of instructional methods (specifically organizational strategies) is determined by three sets of condition variables: (1) team development stages (forming, performing I, and performing II); (2) task process dimensions (procedural/interdependent, procedural/independent, transfer/interdependent, and transfer/independent); and (3) task relationships (subordinate, coordinate, and superordinate). These three sets of conditions define 36 unique instructional conditions, each of which requires a slightly different set of organizational strategies (macro, mid-level, and micro).

Introduction

Team performance and instruction have been somewhat neglected in the field of instructional technology. Since the late 1960s, instructional design and development models have focused almost exclusively on the individual learner. There are several possible explanations for this trend. One could be the contention that team performance equals no more than the sum contributions of the team's individual members. Therefore, instruction should focus on the individual and not on the team as an entity. Another explanation could be that the numerous and complex variables affecting team instruction have caused researchers to postpone working with this difficult problem.

Still, a handful of researchers (Boguslaw & Porter, 1962; Hall & Rizzo, 1975; Kribs & Thurmond, 1977) have pursued the area of "team training" diligently since the mid-1950s. Their work has frequently been set in the military environment, where teams proliferate and the consequences of inadequate team performance are great. However, their contributions, which will be discussed later, have focused largely on identifying conditions affecting team performance. There have been very few models or theories which prescribe instructional methods for training teams.

The purpose of the Team Instructional Prescriptions (TIP) theory (Armstrong & Reigeluth, 1990) is to fill that gap by prescribing a set of integrated principles for designing instruction for teams. The structure of the theory is based on Reigeluth and Merrill's conditions-methods-outcomes framework (1978, 1979). To that effect, team instructional outcomes and condition variables are identified first. Then, for each condition, a set of instructional methods is prescribed for accomplishing the instructional outcomes.

An Analogy

The TIP theory and similar team training theories can be best introduced with the analogy of a marching band. The band is composed of many individual musicians playing their instruments together to form one blended sound—distinct from its individual parts. In the same manner, a team is composed of individual members who work together to perform a distinct team task.

In some cases, the task steps, or parts, of a team task may consist of meaningful individual tasks. For example, the saxophone player's rendition of "Night and Day" may be enjoyed as a stand-alone piece of music (an individual task) or integrated as a recognizable solo into the band's arrangement (part of a team task).

Likewise, a musical duet may represent a simple team task or a subordinate team task. It becomes a simple team task when the two musicians (the team) play without additional instrumental backing, giving the music meaning in and of itself. However, the duet could occur as part of a band's larger arrangement, making it a team task subordinate to the band's larger team task.

Of course, not all band players play the melody. Those who play the harmony perform team task steps which have no meaning when taken out of context. These task steps fit the true definition of the term—they can never be performed as individual tasks nor as subordinate team tasks.

A final critical point revolves around the fact that the analogy is a *marching* band. This emphasizes that the bandleader is instructing the band concurrently on two different tracks: how to play music together and how to march together. Similarly, all team instructional theories must prescribe concurrent instruction in two areas: how to perform a team task and how to function together as a team.

Team Training Literature Review

In "Team Training: Literature Review and Annotated Bibliography," Roland W. Denson (1981) wrote: "Current instructional system development technology does not provide adequate means for identification and consideration of team training requirements. It focuses on identification of individual training requirements" (p. ii).

Denson's bleak assessment prefaced a comprehensive survey of pre-1981 team training literature. Yet, his assessment has held true for the last ten years as well, a notable exception being the Team Evolution and Maturation (TEAM) Model developed by Morgan, Glickman, Wodard, Blaiwes, and Salas (1986). This is not to imply that team training research has been nonexistent. There have been several important studies focusing on identifying condition variables. However, theorists have prescribed little in the form of instructional methods to address these defined conditions. The scarcity of integrated prescriptive

	FIRST MEETING	PHASE I		TRANSITION	PHASE II	COMPLETION
	FORMING	STORMING/NORMING/PERFORMING-I		REFORMING	PERFORMING-II	CONFORMING
TASK INSTRUCTION	Define Technical Skills	Develop Technical Skills	Exercise Skills	Assess Skills	Enhance Skills	Evaluate Skills
TEAM DEVELOPMENT	Define Roles	Develop Communication Network	Exercise Coordination	Assess Role Relationships	Enhance Leadership	Evaluate Leadership, Coordination, Communication

Figure 1. Morgan etal.'s (1986) TEAM Model applied to Naval Gunfire Support Training (p. 32).

theories can be partially explained by examining team training complexities which have plagued researchers since the early 1960s.

The definition of "team" has proven to be a surprisingly complex one. Boguslaw and Porter (1962) differentiated "team" from "small group" by stressing that it is more than a relationship among people—it is "a relationship in which people generate and use work procedures to make possible their interactions with machines, machine procedures, and other people in the pursuit of system objectives" (p. 388). Hall and Rizzo (1975) built upon that orientation by adding that teams are mission-oriented, possess formal structures and assigned roles, and require interaction among members. Wagner, Hibbits, Rosenblatt, and Schulz (1977) confirmed that teams are "relatively rigid in structure" and "goal- or mission-oriented with the task of each team member well- defined" (p. 14). They also contributed a quantitative dimension, specifying that a team can be composed of as few as two "individuals who are associated together in ... activity" (p.14).

A team, then, is a collection of individual learners and a collective learner in and of itself. This dual-track dimension complicates the development of a team instructional theory, for it necessitates prescriptions for teaching teamwork while simultaneously instructing the team in task performance.

Since the late 1960s, instructional design and development models have focused almost exclusively on the individual learner.

Morgan et al. (1986) introduced this dual-track concept in their TEAM Model (Figure 1). This model, or actually theory, defines five stages of team development as its conditions: (1) forming, (2) performing I, (3) reforming, (4) performing II, and (5) conforming.

For each stage, Morgan et al. concurrently prescribe one or more team development actions and a task instruction action. In the "forming" stage, the team defines roles (team development), while also defining technical skills (task instruction). Concurrent instruction on roles and skills is continued through the other four stages. Despite the fact that its prescriptions are broad in nature, Morgan et al.'s work fits the definition of a theory, in that it identifies two basic desired outcomes (team development and task performance) and five basic conditions, and prescribes a sequenced set of strategy components for each condition. These strategy components are discussed later.

In contrast, the team training theory developed by Kribs and Thurmond (1977,1978) for computer-based training emphasizes identification of conditions at the expense of instructional methods. They contend that team structure and the environmental context in which the task is performed are critical conditions that affect team instructional methods.

Environmental context, involving established and emergent task performance situations, was introduced

by Boguslaw and Porter (1962). Kribs and Thurmond (1978) explain Boguslaw and Porter's terms more precisely:

> Team operations occur in a situational context which is a continuum; the end points of which are described as established or emergent. An established situation is one for which performance requirements are specifiable, predictable, and comply with standard operating procedures. In an emergent situation, the environmental conditions during the performance requirements are unanticipated and the state of the system does not comply with standard operating procedures (p. i - "Brief").

Reigeluth and Merrill (1984) draw a similar distinction between procedural tasks and transfer tasks. They define a procedural task as one which can be broken down into a set of standard sequential steps. In contrast, a transfer task is "one for which the procedure for executing the activity varies each time the task is performed" (p. xii).

The second condition identified by Kribs and Thurmond (1978) is team structure, which is based on the nature of the team task:

> Teams operate along this continuum in either serial or parallel (structures). Serial activities are sequential with the input for one team member based upon the output of another. Parallel team structures are characterized by team members performing the same or interrelated tasks simultaneously (p. i - "Brief").

Kribs and Thurmond (1978) relate these conditions to different instructional methods, as shown below:

> For example, if upon analysis of the team tasks, there are significant emergent requirements, then the instructional emphasis should be more on developing problem solving and decision making skills with the individual team members as opposed to training to rigidly structured responses to given situations (p. 12).

Kribs and Thurmond did not pursue the identification of a complete set of instructional methods for each of their condition variables. Instead, they developed a list of "strategies" tied to team development phases in a manner similar to Morgan et al. (Figure 2). In terms of an instructional theory, these "strategies" are hybrid components derived from learning strategies and instructional strategies. For example, the learning strategy variable "mnemonic techniques" is given as a sample strategy for individual team member training. In contrast, one of the "strategies" listed for advanced team training is game-playing, an instructional delivery strategy.

The basic instructional organizational strategy in Kribs and Thurmond's theory is the sequencing of instruction from individual team member training to beginning team training, integrated team training, and "emergent" (or advanced) team training. A sample prescription might

Team Development Phase	Learning/Instructional Strategies
Individual Team Member Training	Comprehension Strategies (e.g., instructional organization, note taking, etc.) Memory Strategies Problem-solving
Beginning Team Training	Drill and Practice Tutorial Testing
Integrated Team Training	Socratic Tutorial Simulation Testing
Emergent Team Training	Simulation Game Testing

Figure 2. Kribs and Thurmond's (1978) ISD approach to developing learning/instructional strategies using CAI modes for team training

be to instruct each team member on his role and the role of other team members prior to moving from a "Beginning Team Training" phase to an "Integrated Team Training" phase.

Although Morgan et al. and Kribs and Thurmond have produced the most complete team training theories we have found to date, other researchers have contributed valuable insights.

The Group Performance Model (Steiner, 1972; Driskell, Salas, & Hogan, 1987) specifies three types of conditions: (1) individual-level factors, (2) group-level factors (e.g., group structure, size), and (3) environmental-level factors (e.g., task characteristics, level of environmental stress). The instructional methods for these conditions are not detailed, but rather lumped under the general heading "Group Interaction Process."

Finally, Hall, and Rizzo (1975) contend that a team's current level of development is a critical condition in determining instructional methods. In other words, for an established team, the "purpose of training is not so much to establish interactive skills as it is to maintain or enhance these skills" (p. 15). The opposite would apply to a team which has been recently formed.

The TIP Theory's Framework

The TIP theory is composed of (1) two instructional outcomes, (2) three types of condition variables, (3) three types of instructional method variables, and (4) an integrated system prescribing what methods, based on the conditions, will optimize the desired instructional outcomes. A definition of each of these is followed by a section describing the theory and its three integrated models.

A principal constraint inherent in the TIP theory is that it "begins" with an already-formed team. It does not address team-forming variables, such as team size, structure (e.g., wheel vs. box organizations), composition, and characteristics of individual team members. These well-researched variables undoubtedly influence the design of team instructional methods and strategies. However, they are excluded here in favor of building a broad-based instructional theory applicable to teams of varying sizes, structures, and compositions. Perhaps future theorists can build on the TIP theory foundation and integrate these team-forming variables into more comprehensive team prescriptions.

Instructional Outcomes

There are two interrelated instructional outcomes in the TIP theory: effective, efficient teamwork, and effective, efficient team task performance. Effective teamwork is typically necessary but not sufficient for effective team task performance. For example, a cohesive, tightly-knit team may not have mastered certain team tasks. Conversely, a disjointed team may excel in task performance because of the contribution of a handful of superior team members.

The goal, however, is to optimize both teamwork and team performance. This can be accomplished only by instructing teams concurrently in team development and team task performance.

Instructional Conditions

The selection of specific team instructional methods is determined by three sets of condition variables: (1) team development stages; (2) task process dimensions; and (3) task relationships, or how tasks relate to each other. These are described in this section.

We have briefly reviewed two team instructional theories, Morgan et al. (1986) and Kribs and Thurmond (1978), which describe team development models. The TIP theory incorporates three team development stages, combining elements from Morgan et al. and from Kribs and Thurmond. It includes the following stages: forming, performing I, and performing II.

The Forming Stage describes a newly-formed team of members unfamiliar with their team roles. As in Kribs and Thurmond's beginning phase, the team members are primarily concerned with functioning as a team. As a result, their ability to perform a team task may be very limited or even impossible without some amount of supervision.

Given sufficient time and practice, the team will mature to the Performing I Stage, where they can perform the task with minimal or no supervision. This is a transitional stage in which teamwork and task performance should receive equal emphasis. A team which progressed no further than this stage should be able to perform procedural tasks, but would likely experience difficulties performing transfer tasks.

The Performing II Stage is the logical extension of Performing I. A team in this stage has reached a high level of teamwork and has shifted its emphasis to maximizing team task performance. It should be able to perform both procedural and transfer tasks effectively and has acquired the capability to evaluate itself.

The team development stages have a direct impact on the selection of instructional methods. For example, the value of role-playing varies with each stage. It has great value for teams in the Forming Stage, who are in the process of defining roles. However, the value of role-playing could lessen for teams in the Performing II Stage, where members are "experts" on their basic responsibilities and interested in role-playing only as one of several methods for learning a new task.

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Whenever considering team development, one must take into account its dynamic nature. A team could fluctuate between the Forming and Performing I stages before reaching a stable point. Likewise, a team in the Performing II Stage could be "bumped down" to Performing I by the addition or loss of team members.

The second category of conditions serves as an umbrella for grouping condition variables which describe task step relationships and the variability of task performance.

As described earlier, Boguslaw and Porter (1962) differentiated between team tasks which were serial or parallel in nature. They defined a serial task as one which requires the completion of one task step prior to the performance of the next sequential task step. A parallel task, on the other hand, contains task steps which can be performed simultaneously by various team members (either individually or in small groups).

The problem with this type of classification is that it shifts the emphasis from the relationships between task steps to the whole task. The TIP theory moves the focus back to the task steps by classifying their relationship as either *interdependent* or *independent*.

For example, when a team of mechanics removes a transmission from a car, it performs a series of interdependent task steps: Disconnect the battery cables; Raise and support the car; Remove the bolts attaching the transmission to the engine; and so on. These task steps are interdependent because the team must perform one before the other. In other words, the end of one step is the initiating cue for the beginning of the next step.

When the relationship between task steps is independent, the steps may

be performed concurrently and/or by different team members or sub-teams. The team task "Build a Car" features task steps which are independent because they are performed concurrently by different sub-teams. One group of workers (a sub-team) may perform the task step "Assemble the engine" while another group performs the task step "Construct the body."

The impact of these task step relationships on the sequencing of team instruction is addressed in detail in the integrated theory section. However, a sample prescription might be that if a team task is composed of independent task steps, then concurrent individualized instruction should be stressed over "whole team" training.

Another task process dimension, in addition to the relationship between task steps, is the variability of task performance. The TIP theory incorporates Reigeluth and Merrill's (1984) distinction between procedural and transfer tasks.

A procedural task is always performed in the same manner and is best represented, on a team level, by military drills such as "React to an Air Attack." Regardless of location, tactical situation, and the size of the team, the task steps remain the same: disperse, seek available cover, engage aircraft with available firepower, and report to higher headquarters. Likewise, the outcomes of an air attack drill remain constant: The team seeks to avoid destruction and destroy/repel the enemy.

In contrast, a transfer task may be performed somewhat differently each time it is repeated. Some of the basic task activities will remain the same, but others will change depending on the situation. The concept is analogous to a very complex flowchart with the decision points representing the variations in task performance. The military task "Attack an Enemy Position" is a transfer task, because its task steps—and its outcome—can vary greatly. Under different tactical scenarios, the military team may be attacking to defeat the enemy, delay the enemy, or deceive the enemy. Likewise, the number and/or sequence of task steps varies depending on the desired outcome and factors such as the type of terrain, amount of time for the attack, and size of friendly and enemy forces. Transfer tasks typically feature more decision-making and more open-ended problems than procedural tasks.

These task process dimensions can be combined to create four task categories as shown in Figure 3. Their impact on selection of instructional methods is addressed in the integrated theory section.

Team tasks are rarely performed in isolation from other team tasks. Therefore, the third and final condition variable in the TIP theory describes the three possible relationships between team tasks: subordinate, coordinate, and superordinate. As discussed in detail later, these condition variables play a major role in sequencing instruction for multiple tasks.

A *subordinate team task* is one that is performed as part of a larger team task. For example, when two members of an instructional development team "Develop a Lesson Plan," they are performing a team task with definable start and end points and the task is also part of a larger team task, "Develop a Training Program." The hierarchical structure of many teams, particularly in the military, makes

Team Process Dimension	Characteristics
Procedural/Interdependent	Standard sequential task steps performed by team.
Procedural/Independent	Standard sequential task steps, but some steps may be performed simultaneously by different team members or smaller sub-teams.
Transfer/Interdependent	Some task steps may vary under different conditions; task steps performed by team.
Transfer/Independent	Some task steps may vary under different conditions; task steps may be performed simultaneously by different team members or smaller sub-teams.

Figure 3. Task process dimension characteristics.

subordinate team task relationships a common occurrence.

A *superordinate team task* is one that is composed of smaller subordinate team tasks. It is the inverse of the previously-described subordinate relationship. To use the same example, the task "Develop a Training Program" is superordinate to the task "Develop a Lesson Plan."

A *coordinate team task* can exist under two conditions: (1) It is performed by the same team either before or after another task or (2) it is performed by a team either before, during, or after a "sister" team's task. For example, "Conduct a Task Analysis" and "Develop a Lesson Plan" are coordinate tasks because they are performed at the same team level (i.e., neither is inclusive of the other) and the first task is performed before the second. Similarly, if one team "Develops a Lesson Plan" while another concurrently "Produces an Instructional Film," then those two tasks may also exhibit a coordinate relationship (i.e., they may be related, but still neither includes the other).

Unfortunately, these three task relationships are complicated by the absence of exclusivity. A task may be subordinate to one task, while being coordinate to another. However, in

terms of prescribing instructional methods, one must determine the primary relationship.

Instructional Methods

The instructional methods in the TIP theory are discussed in terms of three kinds of organizational strategies: (1) macro strategies for teaching large groups of ideas; (2) mid- level strategies for teaching small groups of related ideas; and (3) micro strategies for teaching a single idea.

A common kind of macro strategy is the sequence of instruction in a course or extended block of instruction. The macro strategies employed in the TIP theory borrow their basic premise from the Elaboration theory (Reigeluth & Stein, 1983), which stresses the importance of providing instruction in a contextual fashion. The analogy for the Elaboration theory is that of a zoom lens moving from a wide-angle view (the big picture) to a progressive series of close-ups and then ultimately back out to a wide-angle view. However, the Elaboration theory prescribes a simple-to-complex sequence, while the TIP theory zooms in and back out solely for the purpose of providing a contextual frame for related tasks.

The TIP theory employs macro strategies based on the three task relationship condition variables: subordinate, coordinate, and superordinate. The macro strategy for a task subordinate to a higher-level task can be described as *Context-Task-Synthesis* (C-T-S) (Figure 4). Using the zoom lens analogy, the "context" represents a wide-angle view. It places the subordinate task in the framework of its parent superordinate task. The "task" in C-T-S represents the close-up view consisting of detailed team instruction on the subordinate task. Finally, the "synthesis" in C-T-S moves the emphasis back to the wide-angle view. The subordinate task is integrated back into the framework of its parent superordinate task.

For example, when a tank company attacks the enemy, its commander designates one platoon (a sub-team) to "Provide Overwatching Fires" (a subordinate task) to cover and protect other units. Using the C-T-S strategy to teach the "Overwatching Fires" task, one would: (1) Present a contextual overview of the superordinate company task "Attack an Enemy Position," focusing on how it initiates and ends the platoon task "Provide Overwatching Fires"; (2) present detailed instruction of the platoon task "Provide Overwatching Fires"; and (3) synthesize on a broad scale how the platoon task "Provide Overwatching Fires" combines with other tasks to form the superordinate company task "Attack an Enemy Position."

The TIP theory prescribes a similar macro strategy for sequencing coordinate tasks. It can be described as Context-Task$_1$-Task$_2$-Task$_n$-Synthesis (C-T$_{1\text{-}n}$-S) (Figure 5). As with the Context-Task-Synthesis (C-T-S) strategy, the sequence begins with a contextual overview and ends with synthesis. However, C-T$_{1\text{-}n}$-S accommodates multiple coordinate tasks instead of just one subordinate task. In other words, for each Task$_n$ in the sequence, other coordinate tasks may occur before, during, or after it.

For example, as part of the tank company task "Defend a Position," a tank platoon performs the forward chaining tasks: "Occupy a Platoon Defensive Position," "Engage the Enemy," and "Displace to a Subsequent a Platoon Defensive Position." If we

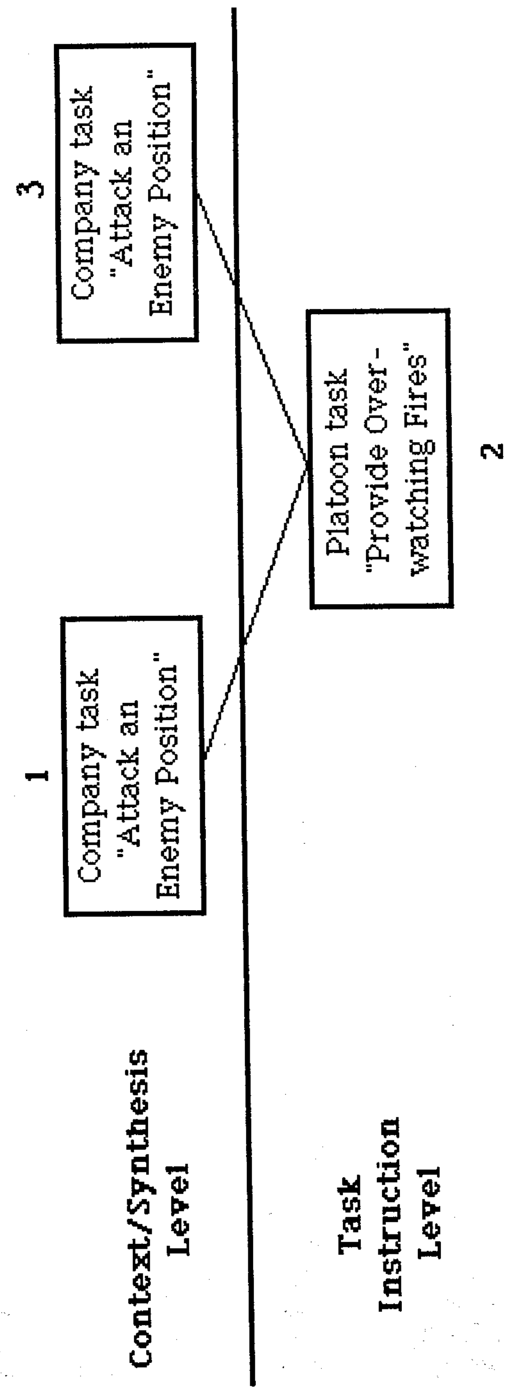

Figure 4. C-T-S sequencing strategy for the platoon task "Provide Overwatch Fires".

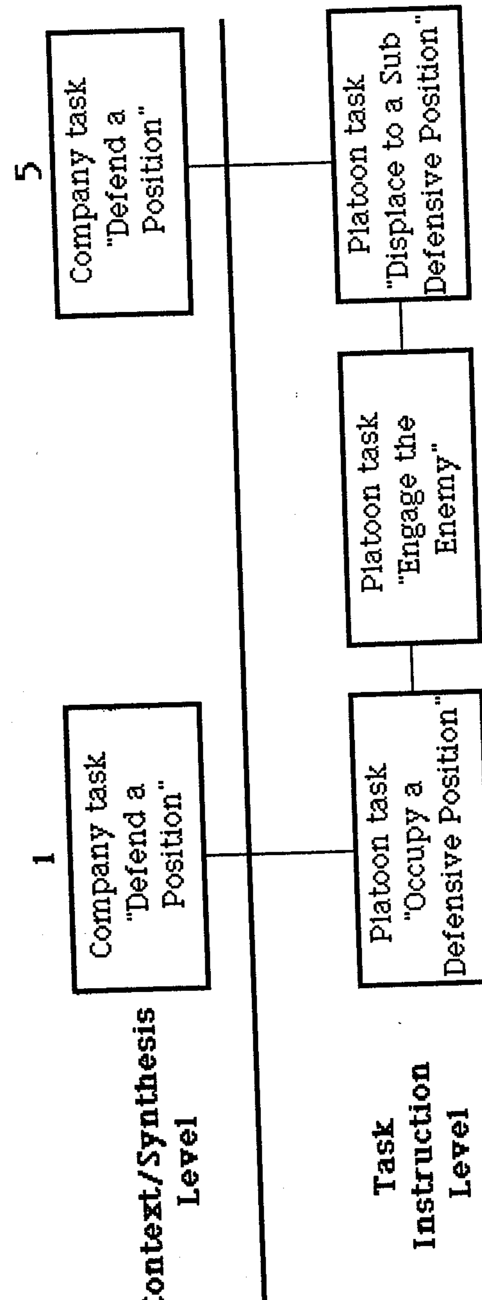

Figure 5. C-T_{1-n}-S sequencing strategy for three forward chaining platoon-level tasks.

want to instruct these three platoon coordinate tasks using the C-$T_{1\text{-}n}$-S strategy, we would (a) Present contextual overview of the company task "Defend a Position"; (b) present detailed instruction on "Occupy a Platoon Defensive Position" and conclude with how it initiates "Engage the Enemy"; (c) present detailed instruction on "Engage the Enemy" and conclude with how it initiates "Displace to a Subsequent Platoon Defensive Position"; (d) present detailed instruction on "Displace to a Subsequent Platoon Defensive Position"; and (e) synthesize the three coordinate tasks back into the superordinate company task "Defend a Position."

The third macro strategy is prescribed for a task superordinate to previously-mastered lower-level tasks. It can be described as Task-$Part_1$-$Part_2$-$Part_n$-Synthesis (T-$P_{1\text{-}n}$-S) (Figure 6). This is essentially the inverse of C-T-S. If we return to the zoom lens analogy, the principal task begins in close-up view. We then move to an extreme close-up to reveal, in turn, each of its parts—the subordinate tasks comprising the principal task. We do not want to give instruction on these lower-level tasks, but we do want to identify them and show how they are synthesized into the principal task.

The T-$P_{1\text{-}n}$-S strategy would prescribe the following sequence for the platoon task "Provide Overwatching Fires." (a) Present instruction on platoon task steps (e.g., "Platoon moves to an overwatch position"); (b) Identify vehicle crew tasks occurring as part of platoon task (e.g., "Crew navigates tank to a specified point," "Crew positions tank in a turret-down position," etc.); and (c) Synthesize crew tasks back into the platoon task.

The three macro strategies are not exclusive of each other, since complex task relationships may require the use of multiple sequence strategies. For example, a platoon task may be subordinate to a higher-level company task while being superordinate to lower-level crew tasks. Thus, the "Task" in Context-Task-Synthesis may initiate a "within" T-$P_{1\text{-}n}$-S strategy.

A fourth macro strategy, not tied to the task relationship condition variables, prescribes instruction in concepts prior to performing practice. This strategy is very similar to Merrill's generality-examples-practice approach (Merrill, 1983), except that it is applied on a macro-level. Concept-teaching and the use of practice are discussed in more detail in the micro strategy section.

Finally, although not described as part of the TIP theory, one could also sequence instruction by other methods, such as the Elaboration theory's simplifying assumptions method (Reigeluth, 1987) and learning prerequisites (Gagné, 1977).

The mid-level strategies in the TIP theory prescribe how to sequence instruction on a small group of related ideas (usually a single task). The two strategies described in this section are based on the condition variables describing tasks with interdependent task steps and those with independent task steps.

A team task which contains task steps which are primarily interdependent in nature should be presented in a task step sequence to the entire team. In other words, if the performance of each task step is dependent upon successful performance of its preceding steps, then the task can be most effectively instructed in the same manner.

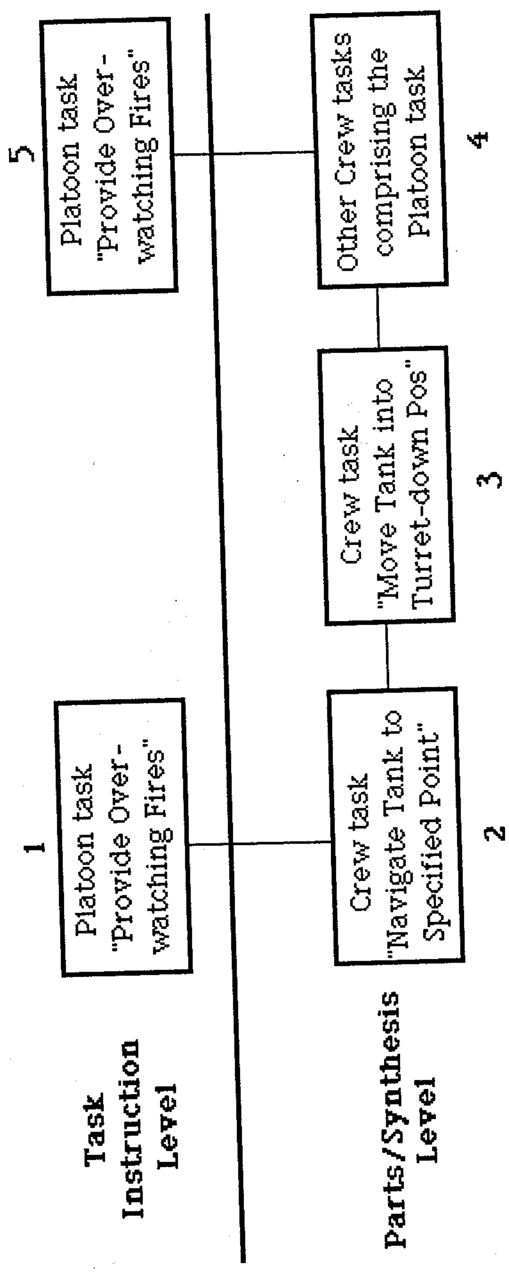

Figure 6. $T_{1\text{-}n}$-S sequencing strategy for the platoon task "Provide Overwatching Fires".

However, an alternate strategy is prescribed for team tasks which contain task steps that are primarily independent. These tasks typically feature team members performing different task steps concurrently. Therefore, a strategy incorporating *concurrent individualized instruction* affords the most efficient way to present instruction. This strategy not only saves time and "focuses" instruction, it also replicates the manner in which the task is performed. It should be noted, however, that team members should be brought together at some point in this instruction (probably during practice) to perform their various parts together—just as they would during actual task performance.

Micro-level strategies are prescribed for teaching a single idea (usually a single concept, procedure, or principle). The common denominator between roles and tasks is their relationship to concepts. Just as a concept represents a grouping of related objects, events, or symbols, a role represents a grouping of related actions performed by one or more team members. This similarity allows concept teaching and acquisition models, such as the ones developed by Tennyson and Cocchiarella (1986) and Ausubel, Novak, and Hanesian (1978) to be applied to role instruction.

These models have already been utilized in the micro-level instruction of cognitive and psychomotor tasks. Thus, they provide a useful framework for instructing teams in both roles and task performance. The concept-based instructional paradigm presented in this section is closely modeled after Tennyson and Cocchiarella's (1986) concept-teaching model. It consists of four variables: (1) label and definition; (2) prototype; (3) role/task discrimination; and (4) practice.

Team development stages have a direct impact on the selection of instructional methods.

The first step in Tennyson and Cocchiarella's concept-teaching model is to label and define concepts, since "labels and definitions seem to help the learner establish in memory the possible connection between existing knowledge and the to-be-learned concept" (p. 56). Likewise, a logical first step in learning a new role or new task is to label and define it. The label for the role of "tank driver" provides an immediate orientation for the new team member trying to learn the role. He probably has an established concept of "driver," even though he expects there to be differences between being a tank driver and a truck driver.

The second step is the presentation of prototypical roles or task performances which enable teams to form a set of common attributes under which all variations can be subsumed (Ausubel et al., 1978). Tennyson and Cocchiarella (1986) turned this into a "best example" and defined it as an "example that clearly represents a typical class member" (p. 57). The use of prototypes in task instruction is firmly rooted in various behavior modeling approaches in which the prototype equates to the modeled performance.

Decker and Nathan (1985) note that the "method of presentation of this performance can be live, videotaped, filmed, or audio-taped" (p. 5). Other presentation methods could also be employed, providing that they maintain fidelity to the actual task performance and performer. For example, a filmed prototype of a motor task will typically represent task performance with greater fidelity than a verbal description of that same task performance. Likewise, instruction will be enhanced when the prototype performer matches, or bears a strong similarity to, the learner.

The third step is role/task discrimination, in which the critical attributes for a given role or task are differentiated from similar attributes present in other roles or tasks. This discrimination can be accomplished by elaborating on attributes and presenting expository and/or interrogatory examples.

Tennyson and Cocchiarella (1986) contend that concepts which have "clearly distinguishable critical and variable attributes" are better learned with examples only (p. 50). In contrast, they prescribe a combination of examples matched with nonexamples for concepts "having multiple, common, critical and variable attributes" (p. 50).

Role and task discrimination is an ongoing process in which teams and team members refine their initial concepts of roles based on additional examples and nonexamples. It occurs as part of any activity in which teams receive salient feedback on their performance (e.g., role-playing, supervised practice, etc.).

Due to its simplicity, practice is often overlooked as an important instructional delivery variable. However, it plays a critical part in role and task instruction, functioning as the vehicle which allows team members to synthesize and enhance team task performance. Practice encompasses a variety of specific instructional methods, to include role-playing, games and simulations, and simple task performance rehearsal. Indeed, these methods frequently overlap, such as when a team member role-plays as part of a team game.

Practice may be team-oriented or individually-oriented depending on the nature of the task being instructed. Team practice is typically prescribed for a task featuring interdependent task steps, where the interaction among team members must be refined through repetition. On the other hand, a task featuring independent task steps often lends itself to individual practice. However, it may still be desirable to reunite individual members for team practice, especially if the team members will be physically located together during actual task performance.

Practice can also be categorized in respect to the amount of applied supervision. For example, army manuals describe a "crawl-walk-run" strategy for training troops. A team in the "crawl" phase receives extensive supervision during practice.When it progresses into the "walk" phase, it becomes more role-proficient and some of the supervision is removed. By the time the unit reaches the "run" phase, it has mastered its roles and optimized its teamwork and therefore can practice independently of any supervision. These three levels of practice can be labelled more descriptively as supervised practice, partially supervised practice, and unsupervised practice. They are similar to Gropper's levels of early, intermediate, and final practice (Gropper, 1983; Salisbury, Richards, & Klein, 1985).

The TIP theory further categorizes methods of practice according to two progressive levels of realism. The first level consists of games, simulations, and drills which recreate part of the actual task performance environment. The second level includes methods, such as Ausubel et al.'s (1978) "dress rehearsals," which take place in the task environment and incorporate as many task attributes as possible.

These levels of realism are not necessarily exclusive. For example, a computer game may be played in a real setting. However, its rules will likely factor out environmental variables other than the setting (e. g., an opponent), thus making the game "less real" than a rehearsal which replicates those variables. Camp, Blanchard, and Huszczo (1986) argue that "virtually all (games and simulations) must limit the range of issues/variables addressed in ways that reduce their absolute fidelity to 'real world' situational counterparts" (p. 220).

The primary purpose of games is to provide teams and individual learners with input/output systems focusing on specific task relationships, rules, and principles. A game may be a simple problem-solving exercise or a complex, rule-driven activity.

Games frequently involve role-playing, which Wohlking (1976) defines as:

> ...an educational or therapeutic technique in which some problem involving human interaction, real or imaginary, is presented and then spontaneously acted out. The enactment is usually followed by a discussion and/or analysis to determine what happened and why and, if necessary, how the problem could be better handled in the future. (p. 36)

Shaw, Corsini, Blake, and Mouton (1980) classify all role-playing as either structured or unstructured, although a continuum certainly exists between these two classifications.

Structured role-playing features predetermined goals and relationships. Van Ments (1989) compares it to "a case study or problem in which there are one or more solutions to be found" (p. 63)." In contrast, he describes unstructured role-playing as "more concerned with allowing the players to explore their own problems or situations" (p. 63). He also notes that these "actions flow freely from the player's own knowledge ... and may take a variety of forms and directions" (p. 63). An example of unstructured role-playing for a tank platoon would be a problem-solving exercise which required the platoon to react to a constantly-changing tactical scenario. In effect, unstructured role-playing should be prescribed for transfer tasks, whereas structured role-playing should be described for procedural tasks.

A simulation is a sophisticated activity which seeks to replicate the "real world" in many important ways. There are many varieties of simulations and, again, entire books have addressed the subject. A key feature of simulations, according to Taylor (1977), is that they provide participants "with decision-making experience over an extended period of simulated time, within a controlled and risk-free environment" (p. 106). Current computer technology has facilitated the development of many large-scale simulation devices. For example, the U.S. Army funded a prototype called SIMNET, which allowed crews in tank mock-ups to engage in computer-generated force-on-force exercises in real time.

A drill is a structured practice session intended to replicate as many task attributes as possible. It may overlap with both games and simulations (e.g., a drill performed in a simulated environment becomes a simulation). However, a drill can also be performed in a natural setting and differ from actual task performance only in its focus on instruction (e.g., the presence of feedback).

The macro strategies employed in the TIP theory borrow their basic premise from the Elaboration theory

Ausubel et al. (1978) describe a similar progression from structured practice, such as games, simulations, and drills, to "naturalistic dress rehearsals":

> Generally, it is only during the latter stages of learning, after component aspects of the learning task have already been identified and mastered in structured practice sessions, that naturalistic "dress rehearsals" become feasible ... unstructured practice does not receive the benefit of skilled pedagogic selection, presentation, and organization of material; of careful sequencing, pacing, and gradation of difficulty; and of optimal balancing of intratask repetition, intratask variability, and intertask variability. (p. 342)

Dress rehearsals are rich in fidelity to actual task performance. Therefore, they provide an ideal transition from learning environment to "real" environment.

The TIP theory also differentiates between methods of practice on the basis of instructional process (the means) and instructional outcomes (the ends).

For example, a game may have specific rules or loosely-defined rules. If it has specific rules, it becomes *process-driven* because it forces players to focus on the process of rule-following. Process-driven methods are prescribed when the "how" of actual task performance is more critical than the outcome, or when environmental factors control the outcome.

If a game or simulation has sketchily-drawn rules or no rules at all, it becomes *product-driven*. In a product-driven method, the emphasis is more on achieving the outcome than on following a specific process. There are many ways in which a tank can engage a target on the battlefield. However, for some tasks, the specific steps employed are of little consequence, provided that the tank crew consistently destroys the target and maintains security.

Process- and product-driven methods are frequently paired to achieve a

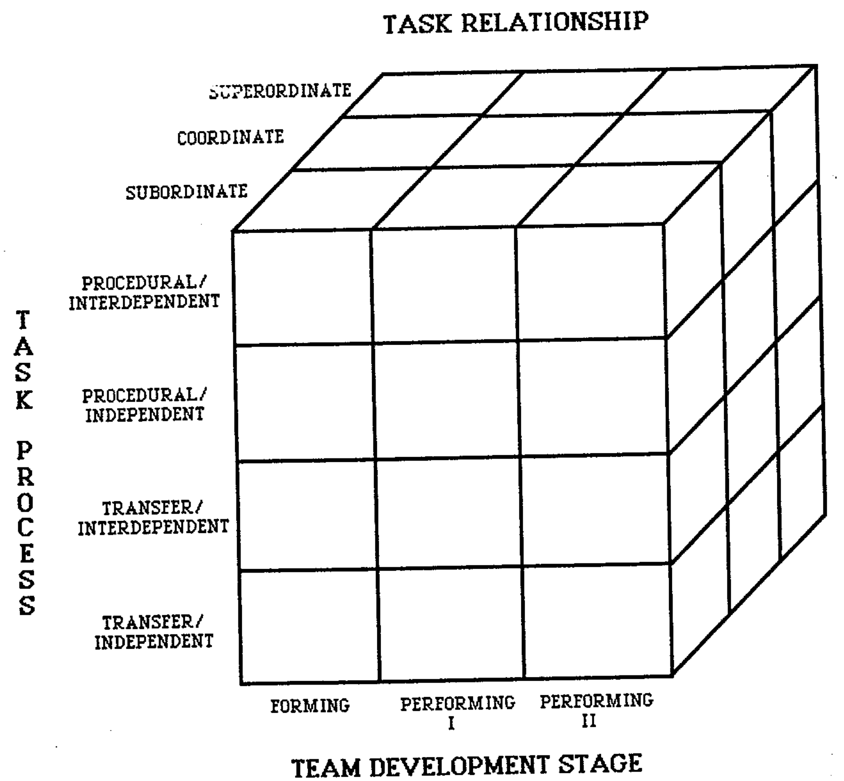

Figure 7. TIP Theory 3x4x3 design three-dimensional rectangle consists of 36 blocks. Each block represents set of instructional methods prescribed for one group of intersecting condition variables.

shaping progression. A crew may be drilled to engage targets using a specific method and then placed into a simulated environment where it is evaluated solely on the basis of number of "kills."

The Integrated Theory and Its Three Prescriptive Models

The TIP theory consists of three models based on the team development stages. Thus, there are separate models for teams in the Forming, Performing I, and Performing II Stages. Each of these models forms a slice of the three-dimensional block representing the TIP theory (Figures 7 and 8).

Furthermore, each slice (or model) consists of twelve bite-size pieces. Each "piece" represents a cell in a four-by-three matrix created by the four task process dimensions and the

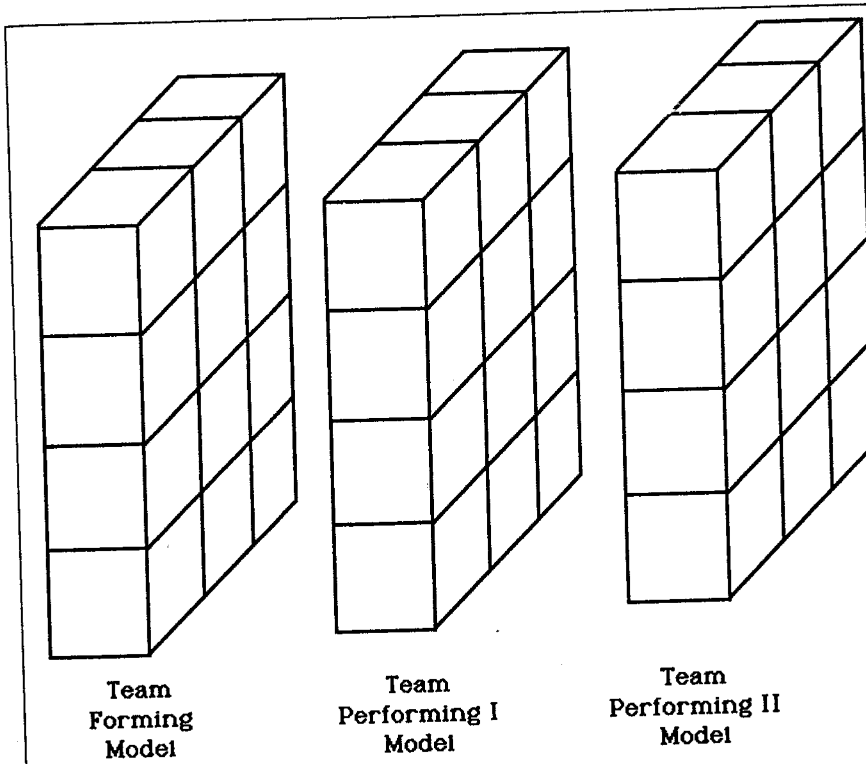

Figure 8. TIP Theory sliced into three models, each containing the four task process dimensions and three task relationships

three task relationships. Within each cell are the instructional methods prescribed for one team development stage, one task process dimension, and one task relationship.

This section will describe the three models using the previously-defined instructional conditions and methods. It will stress the differences between the models, since they intentionally contain many similar prescriptions. For example, all three models contain subordinate, coordinate, and superordinate task relationships. As a result, each model also contains the three corresponding macro sequencing strategies.

Team Forming Model

A team in the Forming Stage consists of team members unfamiliar with their roles. As a result, instruction focuses more on role development than on task performance instruction. However, as discussed earlier, the interrelationship between roles and tasks precludes role instruction without some task instruction.

Both mid-level strategies—task step sequencing and concurrent indi-

	Procedural/ Interdependent	Procedural/ Independent	Transfer/ Interdependent	Transfer/ Independent
Subordinate	C-T-S macro sequencing Task step sequenc ng for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Supervised Games	C-T-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Supervised Games	C-T-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Supervised Games	C-T-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Supervised Games
Coordinate	C-Tn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Supervised Games	C-Tn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Supervised Games	C-Tn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Supervised Games	C-Tn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Supervised Games
Superordinate	T-Pn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Supervised Games	T-Pn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Supervised Games	T-Pn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Supervised Games	T-Pn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Supervised Games

Figure 9. Team Forming Model

vidualized instruction—appear in the Team Forming Model (Figure 9). As explained earlier, task step sequencing is prescribed for instructing tasks with interdependent task steps, while concurrent individualized instruction is the mid-level sequencing choice for tasks with independent task steps.

The concept-based instructional framework—label and definition, prototype, and role/task discrimination—appears in each cell, regardless of task process dimensions and task relationships. Certain practice variables also remain constant in all cells. All teams in the Forming Stage require supervision during practice, since they lack the expertise to provide themselves with useful feedback. Likewise, these teams need to acquire more experience before moving into progressively realistic environments. Thus, teams in the Forming Stage may engage in games, but not simulations and drills.

Other practice variables change across the task process dimensions. For example, practice has a team focus for tasks with interdependent task steps, while it may have an individual and/or team focus for tasks with independent task steps (i.e., some task steps may be instructed concurrently to individual team members, while other task steps are instructed to the team as a whole).

Practice involving procedural tasks is process-driven since the task steps and outcomes remain relatively fixed. An example of process-driven practice would be a game featuring structured role-playing. In contrast, practice involving transfer tasks is product-driven, in that the product (i.e., task outcome) drives the process. In other words, the lack of fixed task steps and the possibility of variable task outcomes requires teams to master a problem-solving approach. An example of product-driven practice would be a problem-solving game featuring unstructured role-playing.

Team Performing I Model

This is a transitional model, in which teamwork and task performance receive equal emphasis (Figure 10). A team in the performing stage has matured to the point where its members possess an understanding of their basic roles. Therefore, instructional methods in the concept-based framework, such as label and definition, apply primarily to task instruction.However, since instruction on new team tasks can alter roles, team members will also undergo a role refinement process.

The other two differences between this model and the Team Forming Model involve the amount of supervision and addition of greater levels of realism during practice.

As its name implies, the Team Performing I Model applies to teams that have developed to the point where they can perform tasks with some success. Hence, detailed supervision during practice is no longer necessary. However, since the team has not yet reached its maximum performing level (i.e., Performing II), some supervision may be required to provide feedback on incorrect task performance. This is the concept behind partially supervised practice, which may be team- or individually-oriented.

Since the team and its members have acquired a working knowledge of their roles, they should be able to function in a more realistic task environment. Therefore, the Performing I Model prescribes simulation and drills in addition to games.These practice methods provide the team with an

	Procedural/ Interdependent	Procedural/ Independent	Transfer/ Interdependent	Transfer/ Independent
Subordinate	C-T-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Partially supervised Simulation, drills Games	C-T-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Partially supervised Simulation, drills Games	C-T-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Partially supervised Simulation, drills Games	C-T-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Partially supervised Simulation, drills Games
Coordinate	C-Tn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Partially supervised Simulation, drills Games	C-Tn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Partially supervised Simulation, drills Games	C-Tn-S macro sequencing Task step sequencing for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Partially supervised Simulation, drills Games	C-Tn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Partially supervised Simulation, drills Games
Superordinate	T-Pn-S macro sequencing Task step sequencing team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Partially supervised Simulation, drills Games	T-Pn-S macro sequencing Concurrent individual for team instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Partially supervised Simulation, drills Games	T-Pn-S macro sequencing Task step sequencing team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Partially supervised Simulation, drills Games	T-Pn-S macro sequencing Concurrent individual team member instruction Role/task instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Partially supervised Simulation, drills Games

Figure 10. Team Forming I Model

	Procedural/ Interdependent	Procedural/ Independent	Transfer/ Interdependent	Transfer/ Independent
Subordinate	C-T-S macro sequencing Task step sequencing for team instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Unsupervised Dress rehearsals Simulation, drills games	C-T-S macro sequencing Concurrent individual team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Unsupervised Dress rehearsals Simulation, drills games	C-T-S macro sequencing Task step sequencing for team instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games	C-T-S macro sequencing Concurrent individual team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games
Coordinate	C-Tn-S macro sequencing Task step sequencing for team instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Team focus Process-driven Unsupervised Dress rehearsals Simulation, drills games	C-Tn-S macro sequencing Concurrent individual team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Unsupervised Dress rehearsals Simulation, drills games	C-Tn-S macro sequencing Task step sequencing for team instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games	C-Tn-S macro sequencing Concurrent individual team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games
Superordinate	T-Pn-S macro sequencing Task step sequencing team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Process-driven Unsupervised Dress rehearsals Simulation, drills games	T-Pn-S macro sequencing Concurrent individual for team instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games	T-Pn-S macro sequencing Task step sequencing team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games	T-Pn-S macro sequencing Concurrent individual team member instruction Task/role instruction: Label & definition Prototype Discrimination Practice: Indiv & team focus Product-driven Unsupervised Dress rehearsals Simulation, drills games

Figure 11. Team Forming II Model

opportunity to replicate as many task attributes as possible, yet still receive expert feedback.

Team Performing II Model

A team in the Performing II Stage has reached a high level of teamwork and has shifted its emphasis to maximizing team task performance. Therefore, although role refinement will continue, the model stresses team task instruction over role development instruction. It differs from the Team Performing I Model in the amount of supervision and addition of greater levels of realism during practice (Figure 11).

Teams in the Performing II Stage have reached a proficiency level where task performance can be improved through sheer repetition and self-feedback. Thus, they can engage in (and benefit greatly from) unsupervised practice in the task environment. This is the concept behind dress rehearsals.

These teams may also continue to learn though games, simulations, and drills. The sophistication of these practice methods may be altered to make them more challenging for Performing II teams. For examples, games may allow for flexibility en route to the game goal or solution. In other words, it may no longer be necessary to devise rules which will lead the game players step-by-step through the task performance process.

In summary, the TIP theory consists of three models based on the team development stages. The Team Forming Model emphasizes role instruction, using methods such as supervised practice and games. The Team Performing I Model gives equal emphasis to role instruction and to task performance instruction, using methods such as partially-supervised practice, games, simulation, and drills. The Team Performing II Model emphasizes team task performance over role instruction using methods such as unsupervised practice, games, simulation, drills, and dress rehearsals. All three models incorporate the three macro strategies (Context-Task-Synthesis, Context-Task$_n$-Synthesis, and Task-Part$_{1-n}$-Synthesis) and the two mid-level strategies (task step sequencing and concurrent individualized instruction).

Conclusion

The Team Instructional Prescriptions (TIP) theory represents an attempt to synthesize team training research into an integrated theory defining instructional outcomes and conditions and prescribing instructional methods. Although many of its parts were derived from empirically-validated data, the integrated theory remains untested.

It is hoped that the TIP theory will provide a springboard for additional work in the much-neglected team training field. Perhaps, other theorists and researchers can incorporate team-forming variables, such as team size, structure, and composition, into the TIP framework.

Additionally, more work needs be done in the area of team cognitive psychology. How can schema theory be applied to a team "collective schema"? How can individual learning theories be adapted to the "collective learner"?

The growing fields of team learning and training are full of complexities to challenge instructional technology's brightest theorists, researchers, and designers.

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