What's Wrong with this Picture? Video-Annotation with Expert-Model Feedback as a Method of Accelerating Novices' Situation Awareness

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ABSTRACT

This paper describes a computer-based training method in which novice learners view video clips of authentic performance situations and annotate the video clips by describing critical incidents that they observe in the video clips and noting the time code where the incident occurs. Experts' observations about the same video clips are offered to learners as expert-model feedback. Learners work to align their observations with those of experts. After annotating multiple video clips and comparing their observations with those of experts, learners increasingly "see" situations more like experts do. This method of *video-annotation with expert-model feedback* is a form of *expertise-based training* (XBT). The XBT approach seeks to accelerate the development of expert-like schema using representative tasks that involve recall, detection, categorization, and prediction—the cognitive sub-skills underlying the situation awareness that is often associated with expert performance. XBT was first implemented in the context of high-speed sports such as baseball, football, and tennis, but can also be applied in more traditionally cognitive domains. The research study reported in this paper provides an example of the XBT method of video-annotation with expert-model feedback being used to accelerate the classroom awareness of teacher education students. The teacher education project is used both to demonstrate the feasibility of the method and also to reveal instructional design issues related to video-annotation with expert-model feedback. The method potentially provides a way to accelerate situation awareness in security, law enforcement, emergency response, and other domains—especially those in which authentic situational video is available for instructional purposes.

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INTRODUCTION

Innovation in an era of global scale and shrinking budgets can lead us to a focus on new techniques rather than new technologies. This paper describes a method that uses established instructional technologies and strategies in new ways. The method is based on the instructional design theory of *expertise-based training* (XBT), which focuses on accelerating novice learners' development of expertise (Fadde, 2009b). XBT draws on expert-novice research methods and principles of psychomotor learning (Fadde, 2010) in order to train cognitive skills, such as situation awareness, that are characteristic of expert performers in many domains. XBT was first developed in the context of high-speed sports such as baseball, football, and tennis, but can also be applied in more traditionally cognitive domains.

An operational principle of XBT is that key aspects of expert performance that are often assumed to come only after extensive experience can be incorporated much earlier in professional education or training programs using low-overhead instructional methods. One "piece of expertise" that XBT targets is situation awareness, as articulated by Mica Endsley (2006), who describes it as "perception of elements in the environment and projection into the near future" (Garrett et al., 2009, p. 97).

The instructional innovation of XBT comes in using well established systematic design of instruction methods such as drill-and-practice and computer-based training (CBT) to target the highly constructivist learning outcome of intuitive expertise as it is represented in Gary Klein's naturalistic decision-making model that has influenced changes in military decision models (Ross et al., 2004). "A central goal of NDM," says Klein, "is to demystify intuition by identifying the cues that experts use to make their judgments, even if those cues involve tacit knowledge and are difficult for the expert to articulate" (Kahneman & Klein, 2009, p. 516).

XBT repurposes the sort of representative tasks typically used in expert-novice research to scaffold both the extraction of experts' situation-bound tacit knowledge and also novice learners' acquisition of the patterns, perceptions, and cues that make up situation awareness. XBT methods don't require experts to explain their perceptual and decision processes but simply to execute them when presented with a task. Similarly, learners are not required to explain their cognitive processes but simply to align their output on tasks with the output of experts on the same task.

This paper first describes the foundational theory of expertise-based training in more detail and then presents a model for the XBT-based method of *video-annotation with expert-model feedback*. The method uses a task that involves identifying critical incidents in video clips of performance situations and noting the time code where the incidents occur. Expert practitioners and novice learners annotate the same video clips and the observations of the experts are offered to the novices as feedback. There are no "correct" answers, only the experts' observations serving as a model for novices to compare their observations to. Over the course of annotating multiple video clips from a variety of performance situations, learners increasingly align their observations with those of experts.

A research project is then presented that used the video-annotation with expert-model feedback method in the realm of teacher education. The project demonstrates the feasibility of the method in a domain that is quite different from the sports context in which XBT has been most fully developed. The project also reveals and addresses several instructional design issues, especially how to measure alignment of learners with multiple experts who have different frames of reference.

EXPERTISE-BASED TRAINING

Expertise theories agree that the acquisition of declarative and procedural knowledge, along with the accumulation of varied domain experience, is essential to the building of expertise. However, it can be a long process with the oft-cited "ten-year rule" maintaining that acquisition of expertise requires ten years or 10,000 hours of deliberate practice—meaning practice, usually under the direction of a coach, that systematically addresses sub-skills and performance deficiencies (Ericsson et al., 1993).

In professional education and training contexts, recognizing the value of experience often leads to calls for more and earlier whole-task learning activities such as internships and immersive simulations (Lim et al., 2008). However, these learning activities also take a long time and there is increasing concern with the need to accelerate the development of expertise in military and other contexts (Hoffman & Feltovich, 2010).

In contrast, *expertise-based training* (XBT) focuses on part-task learning activities that can be integrated early and often in professional education and training programs with the intention of hastening the development of expertise (Fadde, 2009b).

A guiding principle of XBT is that the expert-novice research paradigm that has been applied to the study of expertise and expert performance in many domains (Ericsson et al., 2006) can be repurposed to become an instructional method. Expert-novice research typically involves the creation of a representative task that is completed by both novice and expert performers. Researchers then look for differences between the performance of novices and experts in order to locate aspects of expert advantage.

Representative tasks used in expertise-novice research, and repurposed as instruction in the XBT approach, typically involve one or more of four cognitive activities: Recall, Detection, Categorization, and Prediction (Fadde, 2009a). The earliest application of the expert-novice paradigm appeared in chess studies (de Groot, 1946/1978; Simon & Chase, 1973) and featured a recall task. Expert and novice chess players were tasked with reconstructing the arrangement of pieces on a chessboard that they were shown for a brief time. An international-level player was superior to a skilled but not ranked player in this recall task when the stimulus chessboard displayed an authentic arrangement of pieces but not when the pieces were arbitrarily arranged, leading the researchers to conclude that expert chess players are able to chunk chessboard arrangements and thereby circumvent the then accepted 7 +/- 2 limitation on the pieces of information that people can hold in working memory (Miller, 1956), a number that has since been updated to 4 pieces of information (Cowan, 2000).

Expert-novice tasks designed to isolate components of expert performance and to be repeatable, observable, and measurable have since been devised for expertise research studies in domains such as physics problem solving (Chi, 2006) and radiology (Lesgold et al., 1988) as well as sports. Expertise researchers in sports science have taken the next step of adapting tasks used to measure expert-novice differences in order to train perceptual-cognitive skills such as batting in baseball and cricket, return-of-serve in tennis, and goalie play in hockey and soccer. These training-based studies have shown consistently positive learning effects and may have implications for the training of psychomotor performance in military contexts (Ward et al., 2008).

The use of representative tasks for training purposes certainly isn't novel. Indeed, training in sports, music and other psychomotor domains typically relies on artificial drills that target a sub-skill of performance in ways that offer repetition, immediate feedback, and progressive difficulty—the central attributes of drill-and-practice instructional methodology (Alessi & Trollip, 2000). What is novel about XBT is that it uses drills to target high-level cognitive skills such as situation awareness rather than basic cognitive or psychomotor skills.

The growing body of sports expertise research has implications for the training of expert performance in skills such as air traffic control, vehicle operation, and security that share with sports the characteristics of regularity in performance actions and environment. However, a much wider range of domains also include an aspect of dynamic performance in which XBT may be able to hasten the development of situation awareness as an early expression of expertise. Trial lawyers, law enforcement officers, emergency response personnel, sales people, and classroom teachers all have a stage of job performance in which expertise is typically characterized by having an "intuitive" sense of the environment—and therefore are candidates for XBT.

In many domains and jobs that XBT is appropriate for the performance aspect of the job is, or can be, video recorded. Video recordings of authentic performance situations provide especially rich media material to develop into representative tasks and instructional activities such as the video-annotation with expert-model feedback method that is diagrammed in Figure 1.

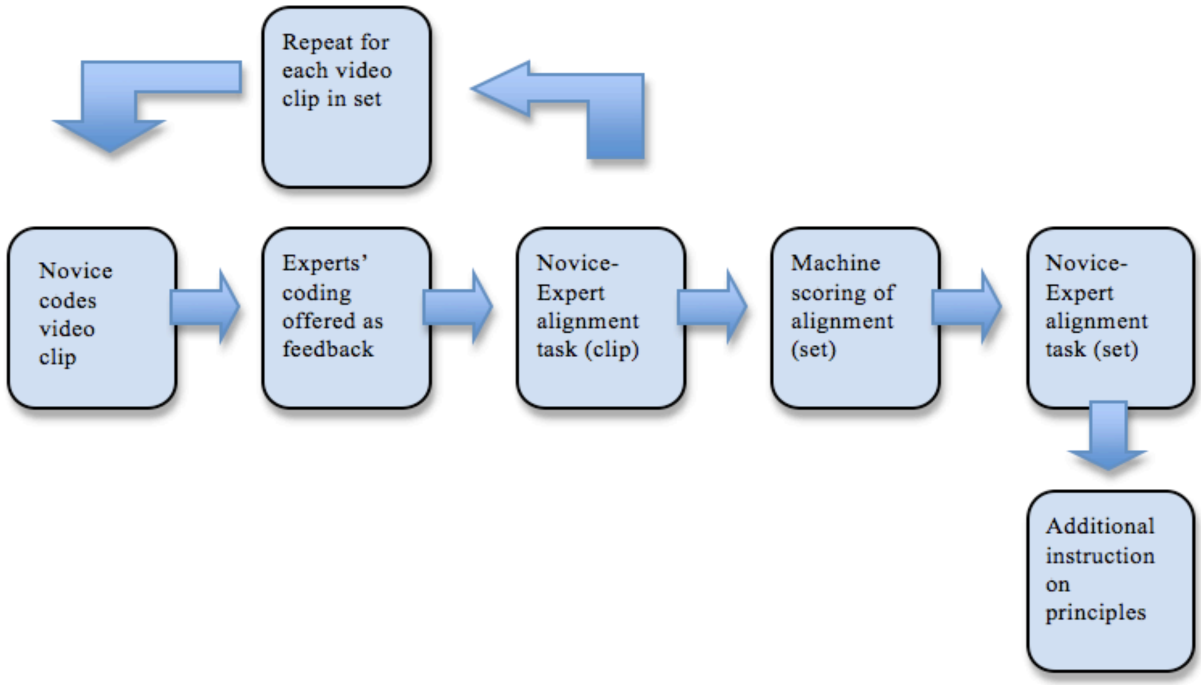

Figure 1. Video-Annotation with Expert-Model Feedback (CBT model)

VIDEO-ANNOTATION WITH EXPERT-MODEL FEEDBACK

The value of packaging XBT activities as computer-based training (CBT) is that it takes what is considered to be context-dependent learning, and pursues a valuable "piece of expertise" using low-overhead, mobile, individualized instruction methods. Figure 1 depicts the model for a computer-based video-annotation activity that uses authentic performance video to *trigger* expert and novice observations. Whether it is a recall, detection, categorization, or prediction task, both experts and novices annotate or "code" each video clip applying one or more frameworks that have already been taught or introduced. The XBT activity is intended to practice applying the frameworks. In this model, the "experts" are not usually instructors but rather are experienced practitioners who may not apply frameworks exactly as the frameworks were taught or presented to learners.

The goal of the activity is for learners (novices) to increasingly align what they observe in a series of video clips with what experts observe in the same clips. While learners could simply be shown the clips and told what the experts observed in the clips, requiring learners to produce their own coding first should induce cognitive negotiation between what they saw and what the experts' saw that engages the schema-building processes (Rumelhart & Norman, 1978). The technique of offering learners a representation of experts' productions to compare with their own productions on the same task has been developed and termed *expert-model feedback* in the area of intelligent tutoring systems (Ifenthaler, 2009). As depicted in Figure 1, learners can also access additional just-in-time instruction on principles of the frameworks if desired. However, the primary mode of learning is implicit learning through alignment with experts—an appropriate strategy for "packaging" the tacit knowledge of experts.

CBT Design Considerations

The video-annotation with expert-model feedback method can support one or more XBT learning tasks:

- *Recalling* what was seen in video clips,
- *Detecting* things that require attention,
- *Categorizing* the things that warrant attention,
- *Predicting* an outcome based on what was observed in a set of video clips.

Because the method requires timely feedback based on each clip viewed, the video clips must be relatively short to allow learners to compare their coded observations with those of experts.

The alignment task that learners perform can be an internal one such as "Reflect on differences between your observations of events and the experts' observations" or it can involve producing a written reflection, a concept map, an essay, or some other artifact. If several video clips are excerpted from a single event then the pattern of learners coding the clip and comparing their coding with that of the experts is repeated until a set of clips is complete.

At natural breaks in the CBT sequence, such as the completion of a set of video clips or when the learner ends the session, the model calls for *scoring* of novice-expert alignment to be recorded by the computer to track learning and also to be provided to learners as feedback. This component of the model is not yet fully developed and philosophical as well as technical considerations enter into decisions concerning how to score novice-expert alignment and how to accommodate feedback from multiple experts that is sometimes contradictory.

Indeed, there are numerous considerations in the design and delivery of the video annotation with expert-model feedback method for which there is little guidance in the literatures of interactive multimedia, intelligent tutoring systems, or expertise and expert performance. One way to advance both the theory and implementation of innovative instructional methods is through design-based research in which an instructional program is designed in accordance with “best practices” of theory and then implemented in order to reveal gaps in theory that suggest further research than can inform instructional design (Wang & Hannafin, 2005).

In the design-based research project reported below, a training project in the domain of teacher education served as a test bed for designing and implementing the XBT method of video-annotation with expert-model feedback. Decisions involved in designing the video-annotation activity are considered first, followed by analysis of learning effects resulting from the experimental implementation.

DESIGNING A VIDEO-ANNOTATION ACTIVITY FOR CLASSROOM NOTICING

In order to explore the portability of XBT methods from sports this implementation of video-annotation with expert-model feedback targeted a domain of performance that traditionally values holistic experiencing of situations and expects learning to be certified through reflection. Teacher education students usually spend an entire semester embedded in a classroom as a student teacher, observing their cooperating teacher and occasionally presenting lessons. They receive feedback on their teaching from the cooperating teacher and a clinical supervisor. Typically, pre-service teachers will consider the expert feedback that they receive and write a reflection about their teaching. Sometimes student teachers’ classroom lessons are videotaped, primarily for self-analysis by the student teacher.

Recently, teacher education researchers have developed video-annotation activities that involve student teachers annotating video recordings of their own teaching episodes. Using computer software that was designed for qualitative research or for video-based game analysis in sports, student teachers mark the running time of the video at which a critical incident occurs and code the incident according to specified criteria (Rich & Hannafin, 2009). Once annotated with time code and comments, video segments can be sorted and compiled for deeper analysis. Sometimes student teachers edit segments from their classroom teaching video and post them to an electronic portfolio to illustrate a written reflection (Calandra et al., 2008).

To date, video-annotation projects have targeted pre-service teachers in the internship stage of their professional preparation and have focused on scaffolding self-analysis and reflection. This project, in contrast, was implemented with students at the very beginning of a teacher education program and aimed to integrate video-based classroom observation earlier in teacher education as a way to help pre-service teachers deliberately practice critical observation of classroom events—defined in teacher education literature as *noticing* (Sherin & van Es, 2005).

Traditionally, film or video of accomplished teachers has been used early in teacher education to model exemplary teaching techniques. Model teaching videos may be authentic case video, or they may be staged videos produced by textbook publishers (Brouwer, 2011). In the early 1990s, a few adventurous teacher education researchers used videodisc technology to create interactive video programs that involved pre-service teachers “coding” model or case video (McIntyre & Pape, 1993; Abell et al., 1996). Assumedly, the method did not catch on because of the expense of producing, duplicating, and playing interactive videodiscs.

Along with viewing model teaching films or videos, the microteaching method that has been used since the mid-1960s incorporates videotaping of pre-service teachers delivering lessons to a simulated classroom of fellow pre-service teachers (Fuller & Manning, 1973). Review of their videotapes by pre-service teachers and their instructor supports written reflection on the simulated teaching experience.

With its long-established use of video and theoretical foundations of classroom noticing, teacher education provided a rich context for developing and implementing an XBT project to train pre-service teachers' situation awareness. Designing the project involved a number of decisions including: what video to use, what task to devise, and who to use as experts.

Selecting and Preparing Video Materials

Since video of themselves teaching in authentic classrooms is not usually available to pre-service teachers early in their teacher education programs, this project used existing video of previous student teachers delivering classroom lessons as the stimulus or trigger video footage for a video-annotation activity. Video of student teachers delivering classroom lessons was not only readily available but it was also appropriate for the learning goal of improving classroom noticing. Indeed, video recordings of sub-optimal teaching can provide a rich window for analysis of classroom events (Sherin et al., 2009), essentially setting up a "what's wrong with this picture?" instructional activity.

Having early-stage pre-service teachers analyze the teaching of inexperienced student teachers is a novel approach in teacher education and could be criticized as modeling poor teaching. However, the modeled behaviors in this project were not the teaching skills depicted in the classroom videos but rather the skills of *noticing* critical classroom interactions, which were modeled throughout by experienced teacher educators.

Because the purpose of the video clips was to trigger observations by experts and novices rather than to understand or to evaluate the original classroom teaching performance, the video clips were presented with minimal context or supporting materials (e.g., lesson plans) provided. Short segments (1-2 minutes each) were excerpted from the original 50-minute lesson videos in order to facilitate small units of analysis that facilitated frequent and timely expert-model feedback.

Devising a Representative Task

In a repurposing of expert-novice research method, both experienced teacher educators (experts) and early pre-service teachers (novices) viewed video clips of classroom teaching and coded the videos for events involving *classroom management* (CM) or *student questioning* (SQ) issues that they deemed to be critical enough to bring up to the on-video student teacher in a 5-minute debrief (see Figure 2 for an example of coding by an expert). This *threshold* for noticing events was included to activate selective attention since expertise research has shown that novices often differ little from experts in being able to see and list events but often differ considerably in judging what is worth attending to (Kahneman & Kline, 2009).

The framework of classroom management was chosen because it is typically the greatest concern of pre-service teachers and the framework of student questioning was chosen because it is a foundation of student-centered teaching and is difficult for pre-service teachers to assess when they first analyze video of their own teaching practice (Calandra et al., 2009). The videos were not edited to purposefully include either classroom management or student questioning incidents and some of the video clips did not contain incidents related to either observational framework, which made the activity work as both a *detection* task and a *categorization* task.

Selecting Experts

Critical design decisions when using expert-model feedback include whom to select as experts and how many experts to use. Teacher education has focused on both pedagogical knowledge and content knowledge with Shulman (1986) arguing that they are separate but both needed. Newer models contend that they overlap to create pedagogical content knowledge (Misha & Koehler, 2006). In keeping with these views, this project used two experts, a pedagogy expert and content expert.

In this implementation of video-annotation with expert-model feedback the experts first annotated two sets of 6 to 8 video clips excerpted from two different classroom lessons. Pre-service teachers then viewed and annotated the same video clips. The novices were then shown the annotations of the experts side-by-side with their own and were instructed to think about differences between themselves and the experts.

Figure 2 shows an example of a time-coded annotation made by one of the experts. The annotations of the experts were combined for presentation to learners as expert-model feedback.

Clip: SB8
<u>Classroom Management issues</u>
1:05 Three students are trying help each other and teacher quashes [not knowing how to use peer assistance].

Figure 2. Example of an Expert's Annotation

The video-annotation with expert-model feedback activity was implemented and researched in the context of a course that introduced new pre-service teachers to their teacher education program.

CLASSROOM NOTICING STUDY

The primary purpose of the classroom noticing project was to determine whether an expertise-based training approach is a feasible and appropriate instructional method in a performance domain that is less well defined than the sports area where XBT approaches have been previously applied. Feasibility is a concern because the video-annotation with expert-model feedback method requires concentrated effort by teachers, trainers, or instructional designers to create and by learners to complete. Therefore, an alternative but lower-overhead method was also developed and implemented for comparison. The comparison to a similar but lower-overhead instructional method grew out of increasing interest in applying principles of lean production to knowledge work (Staats & Upton, 2011), which can and should include instructional design.

The study sought to validate the instructional appropriateness of the activity by measuring participants' alignment with experts on a transfer-of-learning test. Learning transfer in the primary "treatment" of video-annotation with expert-model feedback was compared with a no-treatment control condition and also with an alternative video observation method that involved learners simply viewing the classroom video clips with the experts' observations visible.

Participants

Participants were 55 students from 3 sections of a course that introduced the teacher education program (TEP) of the cooperating university. Students in 2 of the sections met in a computer lab where they were randomly assigned to either the video annotation activity, called the *work* condition because of the coding and alignment tasks that the activity required, or to the *study* condition in which students were instructed to view the classroom video clips while looking at the experts' coded observations. The third section of the course served as a control group. All of the students in the course, including those in the "no treatment" control group, had recently completed lecture/reading units on classroom management and student questioning and had also conducted classroom observations in area schools.

Data Sources

One week after participating in the video observation activities the students in both video observation conditions, as well as the students in the control condition, completed a transfer test of classroom noticing. The printed test consisted of 23 short descriptions of classroom events. Students were instructed to put themselves in the role of a clinical supervisor and to judge each classroom event as:
a) a problem worth mentioning in a 5-minute debrief,
b) a problem but not worth mentioning, or
c) not a problem.

The same experts who coded the classroom videos also took the transfer test and participants' answers were scored for alignment with each expert separately.

Before beginning the video activities the participants in both conditions completed a demographic survey and were also asked to rate, on a scale of 1 to 4, how confident they were that they would "see the same things that experts see" in the video clips. Participants also rated their confidence after viewing an initial set of classroom teaching video clips and again after viewing a second set of video clips.

Findings and Analysis

Table 1 displays the mean agreement of participants in all three conditions with each of the experts. The raw mean score is displayed along with percent correct.

Table 1. Alignment with Experts on Transfer Test

Condition	Agreement w/ Content Expert	Agreement w/ Pedagogy Expert
Study	16.2 (70%)	17.4 (76%)
Work	16.3 (71%)	17.5 (76%)
Control	14.9 (65%)	17.4 (76%)

As shown in Table 1, the participants in both video groups aligned more with the content expert than did participants in the control group. In a test of statistical significance in differences on alignment mean scores, ANOVA indicated a statistically significant difference (T1 + T2 v. Control) $F=5.711$, $p=.020$ with alpha of $p<.05$. The *work* and *study* video groups did not differ in alignment with the content expert on the transfer test. There were no significant differences between participants in the two video groups or the control group in alignment with the pedagogy expert, who was a teacher education faculty member.

Although participants were randomly placed in the *work* or *study* conditions, Figure 2 shows that students in the *work* condition began with less confidence that they would match the experts. These students appeared to suffer a further loss of confidence after their first round of annotating and comparing with experts, but seemed to rebound after annotating and comparing a second set of classroom video clips.

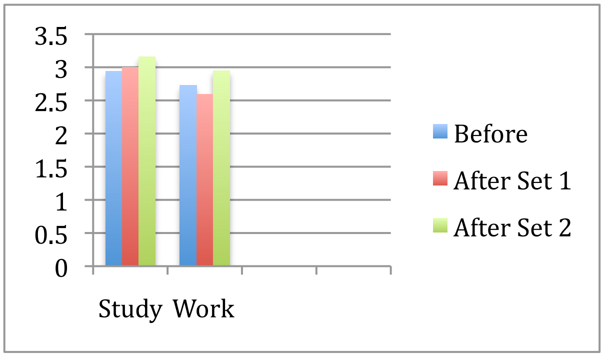

Figure 3. Confidence in Matching Experts

The measure of learners' confidence was included as a "do no harm" check because the full video-annotation with expert-model feedback method represented by the *work* condition is purposefully designed to generate cognitive dissonance in learners. In addition, the implicit learning approach differs considerably from direct instruction or class discussion strategies that students may be more accustomed to. However, both groups ended the video activities more confident than they entered.

Limitations and Conclusions

The classroom noticing activity implemented in this study demonstrates that the video-annotation with expert-model feedback method is feasible to design and deliver. However, the one-hour implementation may not have been long enough for the cognitively challenging annotation and alignment activities to generate the type of schema building that was expected and that should have been observed in the transfer test.

The transfer test, with authentic situations represented in short text-based scenarios and the responses of experts treated as item answers, represents a novel format that has not been validated as an assessment of classroom noticing. Indeed, having different experts complete the transfer test would be likely to result in having different answers on the test. It is interesting to note that students in the control group, whose only encounter with expert-model feedback was the transfer test, conducted a spontaneous discussion among themselves after taking the test in which they debated whether some of the teaching events represented were or were not "a problem worth mentioning in a debrief with the student teacher" in the scenario. It may be worth investigating whether the transfer test itself works as an extremely low overhead instructional strategy.

Although the drop in confidence exhibited by participants in the *work* condition suggests that the video-annotation with expert-model feedback method did induce an element of cognitive dissonance, as was expected, the video-annotation with expert-model feedback method may have been more sophisticated than was necessary for these early-stage pre-service teachers. Lower-overhead methods that still use authentic situations and experts' observations as model feedback may be adequate for very early learners.

Planned future implementations of the video-annotation with expert-model feedback method in teacher education will be longer and will target slightly more advanced pre-service teachers. Having learners make predictions or suggest strategies based on observed classroom incidents could potentially enhance the challenge and learning value of the representative task. As Klein notes, novices are often able to literally "see" the same incidents as experts but are often not able to attach the same meaning or implications.

CONTRIBUTION OF XBT METHODS

XBT approaches, such as the video-annotation with expert-model feedback method discussed here, warrant wider implementation and investigation because they offer efficient and effective ways to train cognitive skills that are associated with expertise but that are often assumed to come only with extensive domain experience or immersive learning experiences such as internships. By addressing the recognition aspect of Klein's recognition-primed decision-making model (Klein, 1998), XBT activities incorporated early in a professional education or training program may prime experiential learning and thereby accelerate the development of novices into expert performers.

XBT methods that involve authentic video of performance situations packaged as computer-based training can potentially supplement simulator-based training in areas such as aviation, security, use-of-force, emergency medical response, and weapons or vehicle operation. While simulator-based training provides opportunities to practice whole-task performance in immersive situations and can be highly effective and engaging, it also requires considerable content and technical expertise to author simulation scenarios and it typically requires learners leaving the field to come to the simulator. Learners can potentially get more out of valuable time in a simulator if their recognition skills have been primed through XBT activities so that they can focus on decisions and actions in the simulator.

On the other end, learners can extend the lessons learned in a simulator by practicing aspects of performance, such as situation awareness, using lower fidelity but mobile instructional methods and technologies that can leverage "interstitial" learning opportunities.

Although simulator-based training is often cost-effective in comparison to training with real objects in real contexts (Fletcher, 2009), it can be made more cost-effective by combining it with lower overhead approaches that target parts of the expertise equation which simulators are not optimized for, including:
1) Drill-and-practice learning through repetition and immediate feedback to build automaticity,
2) Narrow focus on cognitive skills (such as situation awareness) that differentiate expert performers, and
3) Portable, self-paced training.

Research and Development

Garrett et al. (2009) maintain that there are six dimensions of expertise, including Situational Context—which essentially equates with situation awareness. In many of the domains or jobs in which situation awareness is an important dimension of expertise authentic situational video exists, or can be acquired, and is usable for training. In some cases, authentic video is routinely recorded for purposes other than training, such as video of traffic stops by highway patrol officers. In other cases, video is purposefully recorded for performance assessment or improvement, as is the case with classroom video.

For training purposes, authentic video is often dismissed because it presents an impoverished representation of performance situations. Indeed, staged training videos are sometimes produced even when authentic video is available. However, an important contribution of the video-annotation with expert-model feedback method is that it changes the "unit of analysis" from the actual situation to the situation as it appears on the video. Usable video footage does not necessarily need to contain a critical incident, only the cues for a potential critical incident that an expert may notice and pay attention to.

Authentic, if impoverished, video depictions of performance situations also provide both expert practitioners and novice learners with a context to "see" what is *not* visible in the videos. As Klein and Hoffman note, "Novices see only what is there; experts can see what is not there ... to visualize how a situation developed and to imagine how it is going to turn out" (1992, p. 203).

In summary, a simple *what's wrong with this picture?* activity can engage any or all of the XBT tasks (recall, detect, categorize, predict) to train expert-like situation awareness in the context of traditional systematic design of instruction strategies such as drill-and-practice and computer-based training. Validation and tuning of XBT methods such as video-annotation with expert-model feedback will come as trainers and instructional designers develop, implement, assess, and improve the method in a wide range of domains, professions, and jobs that involve rapid decision-making in dynamic performance environments.

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