Learning in Action: How Competent Professionals Learn

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The studies pertaining to expertise development are diverse and broad (Bjork, 1994; Einstein & McDaniel, 2005; Schneider, Healy, & Bourne, 2002), yet empirical research that bridges expertise development into instructional design theories is still in its very formative stages (Ertmer et al., 2008; Fadde, 2009). This article is intended to identify the instructional principles that are effective in accelerating the performance of *journeymen*, considering the significant impact of the journeyman stage and the need for hastening performance in that stage. With the introduction to the major scholarly works and principles that have led to the elaboration of training methods, strategies, and materials, this review of literature proposes a learning model that has four components: (1) development plan, (2) action, (3) reflection-on-action, and (4) remedies.

Industrial nations have undergone a paradigm shift to knowledge-based society (Bell, 1973; Reigeluth, 1999, 2013; Toffler, Longul, & Forbes, 1981). Unlike in past decades, the nature of work has become much more "sociotechnical," requiring close collaboration with multiple teams using complex machines for greater productivity (Hoffman & Hanes, 2003; Moon, Hoffman, & Ziebell, 2009). Coping with complexity in a fast-changing environment requires resilience and adaptivity, which can be facilitated by preserving, sharing, and improving domain expertise (Chi, Glaser, & Farr, 2014; Crandall & Hoffman, 2013; Ericsson, Charness, Feltovich, & Hoffman, 2006; Feltovich, Ford, & Hoffman, 1997; Fletcher, 2009; Gonzalez, Lerch, & Lebiere, 2003; Hoffman & Militello, 2012; Patterson & Miller, 2012; Schraagen, Chipman, & Shalin, 2000; Schraagen, Ormerod, Militello, & Lipshitz, 2012; Ward, Hodges, Starkes, & Williams, 2007; Zsambok & Klein, 2014).

The studies pertaining to expertise development are diverse and broad (Bjork, 1994; Einstein & McDaniel, 2005; Schneider et al., 2002), yet empirical research that bridges expertise development into instructional design theories is still in its very formative stages (Ertmer et al., 2008; Fadde, 2009). From a personal communication with Peter J. Fadde, a scholar whose major scholarly works center on the intersection of instructional systems design with expertise studies, it is evident that traditional instructional design theories have been oriented toward initial-to-competence learning, whereas expertise-based training has focused on the competence-to-expertise learning process (Fadde, personal communication, October 14, 2014). That is, traditional instructional design theories seek to provide effective applications for learning concepts, rules, and procedures—components that are necessary and appropriate for initial learning and competence building. However, research has

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shown that as decision makers grow in experience, they move from rule-based to instance-based decision making (Gonzalez et al., 2003), which requires instruction containing experts' know-how. This calls for a deeper understanding of the process that individuals generally experience in developing expertise.

Expertise Development Overview

Developing expertise requires up to 10 years of experience (Fadde, 2009; Feltovich et al., 1997; Hoffman, 1998; Klein & Hoffman, 1993; Sleeman & Brown, 1982). Responding to the imminent needs for training workers or learners faster, scholars started developing methods intended to help non-experts think and perform like experts, with the goal of achieving more expertise with less time and effort. To meet these needs, instructional designers, curriculum developers, and training programmers have applied a number of widely recognized approaches to identify what to train or teach, including heuristic task analysis (Lee & Reigeluth, 2003), naturalistic decision making (Zsambok & Klein, 2014), macrocognition (Patterson & Miller, 2012; Schraagen et al., 2000), human-centered computing (Hoffman & Militello, 2012), cognitive systems engineering (Hollnagel & Woods, 2005), cognitive task analysis (Clark & Estes, 1996; Crandall, Klein, & Hoffman, 2006; Feltovich et al., 1997; Hollnagel, 2003; Jenkins, 2009; Lukas & Albert, 1993), and the field of expertise studies as a whole (Ericsson, 2009; Ericsson et al., 2006; Hoffman, 2007). Most recently, Hoffman et al. (2013) synthesized empirical bases to propose a concept called *accelerated expertise*, a method to foster an accelerated learning process. However, little attention has been devoted to identifying instructional approaches—"how to teach"—in expertise studies. One of the few research studies that have turned expertise into instructional systems design is the development of the recognition-primed decision-making model proposed by Fadde (2009).

It is surprising to see, however, that research on the development of expertise—in other words, learning—has been relatively neglected despite its significance (Chi et al., 2014). In contrast to the major line of research on the performance and behavior of experts, an emphasis should be placed on learning, because the development of expertise can significantly benefit from a systematic learning process. An effective learning process can be facilitated when the provision of a wide variety of learning principles, "what is," is in line with effective systematic instructional strategies, "how to," for a long-term effect (Vu & Fadde, 2013). Building expertise in a domain inevitably requires a substantial amount of time, for all experts must go through a certain process of developmental phases to elaborate their skills (Ericsson & Smith, 1991). That makes it plausible that we should first understand what learning processes are involved in becoming an expert so that we can provide appropriate instructional supports in a timely fashion, as well as identify markers determining the right timing to move on to the next level of development.

Expertise Development Process

Studies on the science of learning, training, and expertise have introduced several proficiency-stage models. Different models underlie different viewpoints, depending at times on the dominant philosophical underpinnings. To name a few models that contain different viewpoints, classical references such as Hall's (1901) age-based approach, Piaget's (1959) human development theories, and Whitehead's (1929) three-stage model described the learning process from the viewpoint of human development. In contrast, Sosniak's (1985) learning-centered approach in talent development, Alexander's (2004) model of domain learning, Chapman's (2007) conscious competence learning model, and Dreyfus and Dreyfus's (1980) model of skill acquisition emphasized the learning component as the most important consideration; it is an age-free concept from a non-human-development viewpoint.

Of the many proficiency models, Hoffman and his colleagues propose a seven-level proficiency model, which provides a great fit and accuracy in match with the current article in expertise development (Hoffman, 1998). Table 1 summarizes their proficiency categories using traditional guild terms.

TABLE 1	BASIC PROFICIENCY CATEGORIES (ADAPTED FROM HOFFMAN, 1998)
Naïve	One who is ignorant of a domain.
Novice	Someone who is new—a probationary member who has had some ("minimal") exposure to the domain.
Initiate	Someone who has been through an initiation ceremony—a novice who has begun introductory instruction.
Apprentice	One who is learning—a student undergoing a program of instruction beyond the introductory level. Traditionally, the apprentice is immersed in the domain by living with and assisting someone at a higher level. The length of an apprenticeship depends on the domain, ranging from about one to 12 years in the craft guilds.
Journeyman	A person who can perform a day's labor unsupervised, although working under orders. An experienced and reliable worker, or one who has achieved a level of competence. It is possible to remain at this level for life.
Expert	The distinguished or brilliant journeyman, highly regarded by peers, whose judgments are uncommonly accurate and reliable, whose performance shows consummate skill and economy of effort, and who can deal effectively with certain types of rare or "tough" cases. Also, an expert is one who has special skills or knowledge derived from extensive experience with subdomains.
Master	Traditionally, a master is any journeyman or expert who is also qualified to teach those at a lower level. A master is a member of an elite group of experts whose judgments establish regulations, standards, or ideals. Also, a master can be that expert who is regarded by other experts as being "the" expert, or the "real" expert, especially with regard to subdomain knowledge.

Expertise Development Curve

This article is intended to identify the instructional principles that are effective in accelerating the performance of journeymen, considering the significant impact of the journeyman stage and the need for hastening performance in that stage. Also, the selection of journeymen can respond to a profound and continuing need for individuals carrying out complex cognitive work effectively to ensure current and future success in sociotechnical workplaces (Hoffman et al., 2013, p. 3). For presentation of general learning trajectory, Hoffman and his colleagues introduced the curve, namely the "possible proficiency achievement and acceleration curves" (p. 169). On figure 1, the *X* axis refers to time and the *Y* axis to the level of proficiency and the stage of proficiency.

Accelerating the Learning of Journeymen Toward Higher Proficiency

For decades, scholars have successfully identified the qualitative differences between experts and novices, but now attention is centered on how to accelerate filling the knowledge gaps in training programs. This section describes major scholarly works and principles that have led to the elaboration of training methods, strategies, and materials.

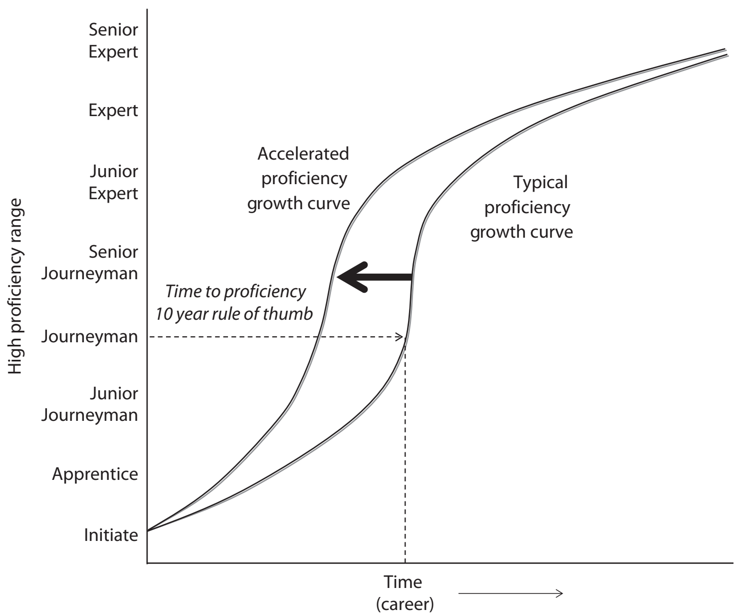

FIGURE 1. THE S-CURVE FOR EXPERTISE DEVELOPMENT (ADAPTED FROM HOFFMAN ET AL., 2013)

Research on Accelerated Learning

One of the most widely accepted findings in the fields of training and learning is that training is dependent on the task and domain. This is in line with the argument of cognitive fidelity, claiming that training is effective when involving authentic cognitive elements used in a real-world task (Salas, Bowers, & Rhodenizer, 1998; Ward et al., 2007). Furthermore, experts are people who have undergone a wide variety of tough cases, challenges that have enriched their knowledge models. Thus, the development of expertise requires both mirroring cognitive tasks in the real world, as well as fostering skill sets that are rarely used but adaptively applied when facing associated problems or challenges.

Another takeaway from prior research on expertise development is that training needs to take into account the learner's level of proficiency. Different strategies may come into play for the improvement of skills and knowledge (Lajoie, 2003), from which initial learners gain advantage from guided instruction, whereas proficient learners appreciate autonomy and challenged learning (Brown & Campione, 1984). This article focuses on the latter—proficient learners—whose levels of autonomy, motivation, and knowledge are high.

Instruction provided for journeymen should reflect the fact that proficient learners tend to learn more from failures than do inexperienced learners, because would-be experts have a strong tendency to stretch the boundaries of their knowledge through corrective feedback rather than enjoying a sense of comfort in the territory they are already comfortable with (Vygotsky, 1980). Those with strong potential to become experts utilize their peers and instructors as a source of constructive feedback, another behavioral indicator of expertise development to be considered (Sonnentag, 2000). Feedback needs to be timely, contributing to sense making and plausibility judgment, as well as informative outcomes and process.

The knowledge models of an expert have been regarded as useful instruments for specifying the knowledge, skills, strategies, and attitudes required for conducting a task and the development of instructional methods and materials (Schraagen et al., 2012). Given that any training programs will rely upon a set of concepts that is important to master (Dawson-Saunders, Feltovich, Coulson, & Steward, 1990) identifying "sticky points" with challenging cases is an especially important task for journeymen. Related to that, researchers advise establishing an authentic learning environment using case libraries, scenario-based learning, and mentoring to accelerate learning (Hoffman & Militello, 2012; Hoffman et al., 2013; Hollnagel, 2003; Klein & Hoffman, 1993; Lajoie, 2003).

Crucial Skills for Expertise Development

When mentoring journeymen for expertise development, several skill sets are essential to foster. This section clarifies why educators and researchers should foster pattern recognition skills, reasoning strategies, and expert knowledge models.

Experts perceive things differently than do novices (Klein & Hoffman, 1993). Recognizing patterns and learning new patterns to interpret phenomena are the prime capabilities for all those pursuing expertise development. Experts can recognize problems and the level of difficulty of problems so that they can take appropriate actions for solutions (Chi, Feltovich, & Glaser, 1981; Feltovich et al., 1997; Glaser, 1985; Hatano & Oura, 2003). Therefore, training should provide cases containing unusualness with several operative cues. For journeymen, it is advisable to provide complex cues, such as relational, dynamic, or interdependency-based cues, rather than low-level cues that facilitate simple interpretations (Chi et al., 1981; Klein & Hoffman, 1993).

The prominent and ultimate goals of expertise development are oriented toward helping learners achieve self-directed learning with self-assessment skills (Fletcher, 2009). Rote learning cannot help journeymen much in reasoning strategically and coping resiliently with complexity. The training should include, therefore, the importance of dynamics, causal reasoning, problem detection, and anticipatory thinking to improve reasoning skills (Fadde, 2009; Feltovich et al., 1997; Fletcher, 2009; Gobet & Campitelli, 2007; Gonzalez et al., 2003). The more expertise an individual possesses, the better metacognitive skills he or she has (Sternberg, 1998). One of the powerful instruments for developing such skills was proposed by Schön (1983) in his notion of the "reflective practitioner." Specifically, Schön (1983) provided guidance for conducting two kinds of reflections—reflection-in-action and reflection-on-action. The major difference between them is the involvement of reflection during or after the performances. Both reflections involve conducting mental rehearsals and mindfulness self-talk and establishing goals on which the learner should focus. Learners are encouraged to focus on the goals rather than on performance (Eccles, 2011; Eccles & Paul, 2008). Scholars believe that trainees can learn self-reflection skills in training programs.

Expertise Development Model for Journeymen

The exploration of pertinent studies focused on expertise development demonstrates the need for the development of a set of guidelines in regard to the promotion of expertise development for journeymen. Journeymen learn best when engaging in a challenging task under a mentor's supervision (Hoffman et al., 2013). Given that journeymen are already competent, gaining a mastery of their skills is necessary to their learning. To this end, instructors, coaches, and trainers should first try to understand at which level of proficiency a learner exists and then create a development plan to help the learner improve. Development plans can occur either informally or formally, depending on the needs and priority of the organi-

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zations and individuals. However, depending on the particular situation, the importance of a formal development plan is different. Idealistically, a well-developed plan represents performers' needs and interests, potential projects to join, and milestone objectives to achieve, through a negotiating process with the mentor or supervisor. The learner then enters a three-stage cycle, consisting of action, reflection, and remedies. This inner cycle repeats until the learner has reached the mastery level of proficiency. The underlying premise of the model is a learner-centered activity, with the ultimate goal of helping the learner become a self-directed learner. Figure 2 represents this expertise development model for journeymen.

Development Plan

This plan is a proficiency development plan. Proficiency, in our view, includes a set of competencies, and each competency is then composed of a set of tasks. In the development plan stage, instructors consider the following components: (1) organization's needs, (2) learner's interests, (3) career plans, and (4) learner's knowledge gaps. Because the instructor is much more accustomed to the domain, has access to higher-level information, and is more perceptive in regard to trends and changes in the task, he or she is more able to determine what competencies need to be cultivated. In the process of negotiation, the instructor and learner can decide in which projects a learner should engage to gain which competencies. Negotiation is the central piece in compromising what learners and instructors view as essential, and it contributes to maintaining a high level of motivation. The development plan should outline specific projects and related tasks. The competency modeling (Shippmann et al., 2000) method may be useful in this stage when articulating which competency a learner wishes to develop, which, in turn, helps to assign specific tasks for targeted competency development.

Action

Competent professionals are busy with everyday tasks. Thus, learning for journeymen mostly takes place by participating in projects. As journeymen are able to carry on duties without supervision, they often lead

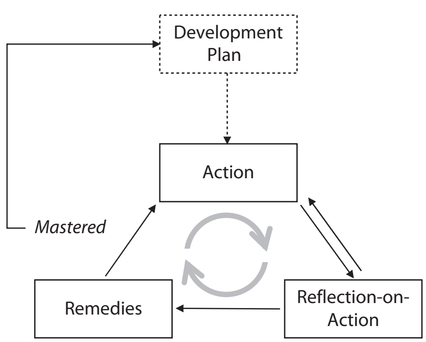

FIGURE 2. EXPERTISE DEVELOPMENT MODEL FOR JOURNEYMEN

and perform the tasks. The *action* stage primarily involves two activities: (1) constant self-evaluation and (2) whole-task performance.

Recognizing realistic concerns about the time constraints created by formal instruction for journeymen, Fadde and Klein (2010) proposed a deliberate performance model, which

> . . . is closer to just-in-time training that uses job situations as opportunities for learning. Like just-in-time training, deliberate performance is more appropriate for people who are already competent in their jobs than it is for initial learning by novices. The difference between these two approaches is that just-in-time training usually focuses on learning particular skills and procedures, whereas deliberate performance focuses on building the tacit knowledge and intuitive expertise that are associated with extensive job experience. (p. 6)

In other words, *just-in-time* training focuses on part-task practice, whereas deliberate performance emphasizes whole-task performance for developing intuitive expertise (Fadde & Klein, 2010; Van Merriënboer, 1997; Van Merriënboer, Kirschner, & Kester, 2003). Deliberate performance is particularly important for journeymen because it helps them build a self-coaching competency with which they can design personalized-pace practice opportunities out of work routines and provide their own feedback—becoming self-directed individuals (Knowles, 1975). Therefore, deliberate performance exercises should (1) be tied to everyday job performances without putting excessive extra time, (2) not affect the performance of the job task at hand, (3) offer varied repetitions with timely feedback, and (4) not require expert judgment for feedback—self-directed activities (Fadde & Klein, 2010, p. 8). Conducting these four processes while performing real work tasks can facilitate deliberate performance.

1. *Estimation*: An estimation of time or resources can enhance *situational awareness* of the interconnected elements in a task or an environment. In a business setting, for example, business meetings can offer contexts within which to practice estimation skills. If a meeting agenda is prepared in advance, a learner (e.g., a businessperson who is self-directing his or her own learning activities) can recognize the expected time necessary to walk through each item, taking into consideration the specific context, skill sets, resources, and stakeholders involved. The businessperson can then have a better sense of what types of and to what depth the agenda items will be discussed in the given time. Sufficient repetition and variety are particularly effective in regard to improving accuracy in estimation. Estimation practice is highly recommended for participants of a meeting, not a manager, to build *situational awareness*.

2. *Experimentation*: Trial-and-error in learning is a well-known strategy for discovery and reasoning. Journeymen often try new ways of completing a task to improve performance quality. During this process, they must decide whether to either adapt or reject their hypothesis. Thus, the outcome of the experiment is either to maintain expertise or develop expertise. Schank, Berman, and Macpherson (1999) stated that experimentation is perhaps the most important learning process.

   Experimentation is similar to the *pilot-test* concept, and Schön (1983) proposed a similar concept called *reflection-in-action* to outline the process of conducting experiments. For this concept, learners conduct an exploratory experiment in which individuals undergo a playful activity to grab a sense for things. The next step is to go a testing experiment in which learners act to make desired changes. Here learners decide whether to adapt or neglect the changes by critically judging both the expected and unexpected achievements. The final stage of this process is hypothesis testing, in which learners try out alternative hypotheses and conduct comparisons and contrasts to determine the optimal outcomes. An example of this process would be a professional truck driver who must find a different route by utilizing his or her cumulative knowledge and navigational intuition. Based on the results, the truck driver might decide to adopt the new route or never travel it again.
3. *Extrapolation*: In brief, extrapolation focuses on employing critical lessons learned (i.e., recycling prior incidents). The purpose of conducting extrapolation is to establish a strong mental model (i.e., schema), which is very effective in finding a heuristic way to extract fundamental principles, situations, and rules of thumb to deal with given tasks. Both failures and successes from past experiences are useful in situations where learners sense "red flags." When these unanticipated situations occur, learners must become introspective in regard to the sequence of events completed up to that point or ask for help and advice from colleagues or mentors. Extrapolation is believed to prevent the inertia effect (i.e., the tendency to perform tasks as one has done in the past). Examples of extrapolation include the archival of precedent cases in a law firm or any knowledge management database in an organization.
4. *Explanation*: This process is used to share what learners have found during the above three stages (i.e., estimation, experimentation, and extrapolation). Although explanation somewhat overlaps with our next learning process (i.e., reflection-on-action), it is largely different from the latter in that it seeks judgment from others, whereas reflection-on-action emphasizes a self-directed reflection process. It is also noteworthy that scholars have found explanation in deliberate performance somewhat inaccurate due to variety of situations (Klein & Hoffman, 2009).

Reflection-on-Action

Reflection-on-action helps learners conduct self-evaluations, guided by a mentor after performances, and aids them in becoming reflective practitioners with high metacognitive skills. This method is regarded as particularly important and effective for junior (and senior) professionals. According to Schön (1983), who developed this method, "We reflect *on* action, thinking back on what we have done in order to discover how our knowing-in-action may have contributed to an unexpected outcome" (p. 26). Unlike reflection-in-action, this type of reflection involves stepping back from the situation to debrief and describe what has gone well and wrong as well as what should have been done to acquire a better performance. When revisiting the performance, learners then self-talk and self-defeat to look for cues to positive actions.

Goal-setting needs to follow, in which learners are encouraged to set up action plans, milestones, and execution processes for plans with the support of instructors. The roles of the instructors, therefore, include providing guiding questions and quality feedback as well as describing the discrepancies between learner- and instructor-perceived performance gaps to negotiate the remedy plans.

The results of reflection-on-action can be two fold. First, the instructor might help the learner become *aware* of what he or she should have done. Second, the instructor might find an area of task expertise in which the learner needs a set of instructional interventions (i.e., a remedy) to gain improvement. Depending on which result(s) the learner receives, the instructor assists the learner to select the next action.

Remedy

Upon completion of the reflection-on-action stage, the instructor and learner should have identified areas for improvement. Learners who only need *realization* will skip the remedy stage, but those learners who have identified a need to develop a deeper understanding (e.g., causal models) or conduct research to discover additional information are aimed at advancing to the remedy stage for treatment. Due to cumulative experience, instructors are able to guide the learners in regard to what materials they should reference, which strategies they should employ, and which milestones they should establish for a systematic learning process. The process then entails providing the resources relevant to the case for the learner and rationales for why the learner should learn particular skill sets. Then, the instructor should assign the learner learning activities. Here, the principles of feedback, transfer distance, and retention come into play, depending on the nature of the learning deficiency (Schmidt, 1991).

When it comes to establishing instructional plans, the goals should focus on fostering pattern recognition skills, reasoning and critical thinking skills, problem-solving skills, and causal models identified by an expert. The maintenance of motivation is also important as it can be manipulated by the instructor to help balance successes and failures by adjusting the difficulty of the part-task practice. For a cost-effective learning process, instructors may provide task-specific case libraries, video-lectures for self-learning, or, sometimes, only guidance in the form of cues for further learning. Again, all instruction is oriented toward self-directed learning for the future benefit of the journeyman, while the facilitation of learning is a concern that should be taken into account. The next real work performance could serve as an indicator of skill acquisition (Knowles, 1975).

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When the learner reaches the mastery level of proficiency, the instructor and learner engage in another round of proficiency diagnosis in the form of a reflective review session to see whether the learner has successfully attained the desired competencies. If attained, they will then establish a new set of development plans. This process repeats until the journeyman becomes a junior expert.

Conclusion

Although the empirical foundation of the experts–novices paradigm is abundant, much is still undiscovered as to how to accelerate closing the expert–novice performance gaps. After reviewing the literature on learning and training, we believe that journeymen develop their expertise through repeating development plans, actions, and reflection-on-actions and, if necessary, partaking in remedies. Theoretically, journeymen are believed to accelerate their learning process by conducting deliberate performances while engaged in real tasks. After performing tasks, it is imperative for them to reflect on the situations by describing what happened, seek alternative methods of competition for better performances next time, and set up a systematic plan for performance improvement. Mentors should always monitor journeymen's performances, while also cautiously providing feedback and direction.

Achieving more with less is the goal of almost every organization. Further investigations into expertise development should develop detailed guidelines and methods to accelerate tailored expertise in a domain. In addition, expertise development for different levels of proficiency, such as apprentice, senior journeymen, or junior expert, can contribute to the knowledge base of expertise development.

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