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Mastery learning and deliberate practice: Do simulationists need clarification?

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Abstract

Background. When the concepts of mastery learning and deliberate practice are applied in accordance with their intended meaning, they can be used to create robust learning opportunities that can ensure that more learners achieve and maintain higher standards of competency. With the rapid expansion of healthcare simulation over the past 10–15 years, these concepts are not always described accurately in the literature, leaving those considering the use of these practices vulnerable to inaccurate interpretation and application.

Aim. The purpose of this article is to provide a much-needed clarification of mastery learning and deliberate practice for those conducting simulation-based education. This clarification includes defining background information on these two important concepts and suggestions for application.

Conclusion. An accurate understanding of mastery learning and deliberate practice can ensure that going forward, we properly design interventions, systems, and research protocols that can inform us about what works best for our learners.

Keywords

competency, deliberate practice, mastery learning, medical education, practice, simulation

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Introduction

In the past decade, we have witnessed the expanded use of simulation in healthcare education, although "it is often said that healthcare is 20 years behind other industries" (Brailsford et al., 2017, para 4.3). During this time, practitioners, researchers, and authors had to describe what they do to investors, reviewers, and readers and why it was done in a particular manner. Consequently, it was necessary for them to locate the theoretical frameworks that supported their practice and research. Two key concepts in education carried over to the healthcare simulation community included *mastery learning* and *deliberate practice*. Lately, many of us have witnessed authors and presenters in the simulation-based education community who may be unintentionally misusing or misapplying these two concepts. For this reason, it is not easy to locate exemplars for mastery learning and deliberate practice in the literature because these two concepts are usually not described accurately or do not match the original, intended meaning. This article describes mastery learning and deliberate practice as intended in the original context. When applied within their intended meaning, mastery learning and deliberate practice can be valuable approaches for encouraging, developing, and maintaining competency.

Why mastery learning and deliberate practice matter

A former colleague of mine had two young daughters. One fell off a piece of furniture, struck her face on an object, and cut her face open. He was an emergency medicine physician and any number of people, including him, could have sutured her facial wound in the clinic. On the way to the emergency room, he was on the phone, calling a friend of his who was the best at performing facial sutures. He wanted this physician to perform the procedure because he wanted to minimize scarring and he felt that this was especially important for a girl. The person he selected to do the suturing did not master that skill by chance. It may have started with structured practice as a medical student or resident, but mastering this special skill required hours of practice and personal reflection. This level of mastery, being able to suture a child's face, leaving the scar almost unseen, was also not likely achieved in a single session of practice and feedback by an attending physician during residency. Additionally, the physician must have had an internal desire to be the best at this skill and looked for ways to master it. This is the outcome of ongoing learner-driven deliberate practice at its best.

Once a practitioner learns a skill or procedure, practice is needed to maintain the level of competency. Recent groundbreaking research shows that most medical errors reported in the research literature are attributed to errors of omission and errors of commission (Clapper & Ching, 2020). Failing to act, or act in time can result from a lapse in knowledge or skill. Furthermore, with so many skills and procedures to know, it is nearly impossible for clinicians to maintain a high state of competency in every area. A reflective practitioner may be aware of their own status and will seek practice opportunities to refresh their knowledge and skills on a regular basis.

Mastery learning

Researchers (Baumann & Barsness, 2018) recently posited that mastery learning is a gold standard for competency-based learning in simulation-based education. The intended message by these researchers and many others is admirable and well intentioned. Continuous practice can lead to some level of competency in several areas (Crea, 2011) and that should be the aim of every clinical provider. Bloom's (1968) concept in teaching, referred to as *mastery learning*, is often misinterpreted to imply that it is an instructional technique (Petrosoniak et al., 2019); something it is not. In healthcare simulation, mastery learning is sometimes described as a one-time experience where the learner can practice multiple times repetitively with feedback (Doughty et al., 2015; Hunt et al., 2014; Taras & Everett, 2017). When described in this manner, these experiences consist of a simulationist providing feedback and practice until the learner achieves a desired outcome, normally in the form of a score on an evaluation. Unfortunately, this approach cannot be considered mastery learning. The learner does not achieve mastery from a single session, no matter how many times they practice, and we cannot ascertain that the outcome was not by accident and that it is repeatable.

Bloom's (1968) concept of mastery learning was meant to provide a robust approach to learning that enables all students "to master the subject under consideration" (p. 1). Learners may need more feedback and more time than others to learn certain concepts (Baumann & Barsness, 2018; Bloom, 1968; Ericsson, 2008). Bloom described a positive learning environment, with time granted to each student to achieve a predetermined standard of competency in a subject. Mastery learning *does not occur in a single session*, but rather over a period of weeks, months, or even years (Kulik, C-LC., Kulik, J.A., & Bangert-Drowns, 1990). The student masters predetermined concepts with perseverance, practice, and feedback from the course facilitator (Bloom, 1968). Bloom recognized perseverance over a period, as in a semester of algebra. He suggested that rather than using grades, tests should be marked to show "mastery and nonmastery" (p. 9). A student receiving a letter grade or mark of mastery on a single test would not be demonstrating mastery. A consistent mark of mastery *on several exams in that unit* of algebra would be a better indication of mastery *in that subject*. Mastery learning has been shown to have a strong educational effect. A meta-analysis by Kulik et al. (1990) showed that mastery-learning programs raised final examination scores from the 50th to 70th percentile in upper elementary education through college.

Although mastery learning requires additional planning and resources, the concept is relatively simple. A math teacher would introduce an algebra concept in a unit of instruction. The teacher may notice that a couple of students may not be progressing well. The teacher provides additional practice, feedback, and multiple assessments to ensure that all learners, including the ones who did well, can achieve the learning objectives consistently (Guskey, 2010). This ongoing cycle of practice and assessment continues not only through the session, but also *throughout the unit* until all learners regularly achieve high performance in the topic.

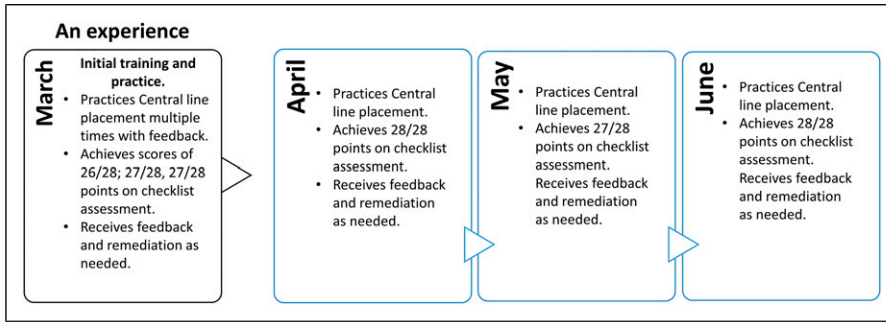

Figure 1. Mastery learning.

We can apply this concept to a healthcare skill such as central venous (central line) catheter placement. As shown in the example in Figure 1, practitioners are provided instruction and multiple practice opportunities during a session in March. Through ongoing assessments, the participants consistently achieve high checklist marks. Returning in April, May, and June, the practitioners continue to achieve high marks on the checklist. It is important to emphasize that each session provides the practitioner with practice, feedback, and remediation as needed. Additional time and resources are allocated during initial stages to allow students with weaker content knowledge backgrounds to reach proficiency (Kulik et al., 1990).

Mastery learning can be applied to almost any skill or procedure where a high level of competency must be achieved and maintained. Of course, if a practitioner does not perform that task for a while, competency can wane. While not always the case, the practitioner may be the first to recognize that they have not performed a skill or procedure for a while and require some refresher training and practice. This is where *deliberate practice* emerges.

Deliberate practice

Deliberate practice (DP) is another concept often described incorrectly. Deliberate practice is an experience that the learner participates in because *they* have reflected on their own needs and determined that they need to revisit a particular skill or topic (Clapper & Kardong-Edgren, 2012). That is, they *deliberately seek out opportunities to practice* because of a perceived or actual deficit in their knowledge or skillset or perhaps just a desire to improve and reach a higher level of competency or expertise. Deliberate practice is often confused with *repetitive practice*. Deliberate practice can contain repetitive practice, but repetitive practice *is not* deliberate practice. As observed by Ericsson et al. (1993) "… maximal level of performance for individuals in a given domain is not attained automatically as function of extended experience, but the level of performance can be increased even by highly experienced individuals as a result of deliberate efforts to improve" (p. 366). Deliberate practice includes opportunities that

the individual pursues in a domain of their choosing with the explicit goal of improving performance. With deliberate practice (Ericsson, 2008), "external rewards are almost completely lacking." The actual reward is achieved *internally* through higher standards of performance.

Practice versus deliberate practice

The *act of practicing* a skill is common to the concepts of both *practice* and *deliberate practice*. Directed practice is not deliberate practice because while learners may need to refresh on a particular skill, this act is not internally driven. A football coach can call for team members to practice a tackle technique. The linebackers may line up on the field and practice the drill, while the coach provides feedback. This is practice. They can also practice several times in succession, even doing so rapidly, while receiving feedback. This is *repetitive practice*.

Another member of the team, a field goal kicker is anxiously aware that an important game is approaching and feels that he may not be at the level of performance needed for this championship event. He stays on the field after his team departs and practices. While practicing, he notices that he is placing the ball between the goal posts each time but slightly too far to the left (feedback). With additional practice, he can kick the ball consistently through the posts, staying in the center. This is deliberate practice.

In my organization, we recognize that all our clinical providers may lose confidence or competency in clinical areas that present less frequently. Extracorporeal membrane oxygenation (ECMO) is one example. It is not often that babies require ECMO to circulate blood through an artificial lung back to the baby. Placing a baby on ECMO is not an easy task and clinicians must maintain proficiency from setup to removal of the device, along with being able to troubleshoot mechanical and other issues in an instant.

Our department does not wait for individual clinicians to recognize that they may not be at a high state of readiness to operate the ECMO device, so ECMO training is regularly scheduled. This is *not* deliberate practice as the individual or group of practitioners did not seek this training on their own to improve their level of competency. The decision to engage in practice was facilitator driven. It was not based on an individual's internal drive or motivation. Department leadership had felt that a system of initial and ongoing refresher training sessions was required, and therefore, they scheduled the sessions for the participants.

On the other hand, a provider recently came to the simulation center to practice with the ultrasound and central line simulator. He came on his own for additional practice because it had been a while since he placed a central line. Using the ultrasound probe, he guided the needle into the vein, which he viewed on the monitor. He simultaneously glanced at the needle-syringe and saw the flash of simulator blood of the correct color. This feedback mechanism confirmed that the needle was in the right place. He withdrew the needle and practiced that step again until he felt confident using the ultrasound to locate the tip of the needle in the vein. This *internally driven* practice session was deliberate practice in action. This learner may have a mastery goal orientation and

strong internal motivation best described by Cook and Artino (2016) in the following passages.

> Learners with a mastery goal orientation…have a self-theory that intelligence and ability can increase or improve through learning (an 'incremental' mindset). People get smarter (or better at basketball or art) by studying and practising. This mindset leads people to seek learning opportunities because these will make them smarter (p. 1008).

It is in this second passage that we see that motivation to reach out for deliberate practice can be inspired by outside forces, but again, it is generally internally generated and driven.

> The motivation of a medical student who does his homework for fear of punishment is very different from motivation to learn prompted by a sincere desire to provide patients with optimal care. Deci and Ryan proposed that these qualitative differences arise because of differences in the degree to which external forces have been internalised and integrated (assimilated into the individual's sense of self) (p. 1010).

Table 1 provides a general summary and flow for both mastery learning and deliberate practice. Having a thorough understanding of these two concepts may aid facilitators and simulationists with making suitable decisions for enacting and encouraging their use.

Some may be familiar with the Internet suggestion that it can take 10,000 hours of intentional, deliberate practice to reach expertise. This idea, that a predetermined number of hours is a major factor for achieving mastery and expertise came under some scrutiny (Campitelli & Gobet, 2011), including by Ericsson (2013) himself, who stated that he never implied that requisite in his articles. Campitelli and Gobet estimated that mastery may be achieved in 3000 rounds of practice, but other factors including genetic differences, cognitive ability, and starting practice at an early age are also important factors to achieving expertise. Similarly, Hambrick et al. (2014) found that in all the domains where DP has been studied, changes in performance were not explained by the number of hours but often by factors such as starting age, working memory capacity, and genetics. Perhaps most importantly may be the message that Ericsson et al. (1993) posited that years of research on learning and skill acquisition found that the most important condition is the person's "motivation to attend to the task and exert effort to improve their performance" (p. 367). This research-supported statement aligns well with the definition provided at the top of this section. *We do not provide deliberate practice to our learners.* Our learners seek deliberate practice opportunities because of that *internal need* to refresh or improve.

The execution of deliberate practice also aligns well with the concept of mastery learning. As with mastery learning, deliberate practice sessions allow learners to *receive immediate feedback* and correction, while having multiple opportunities to practice, with the aim of achieving a higher standard (Ericsson, 1996; Clapper &

Table 1. General flow of mastery learning and deliberate practice

Mastery Learning (Facilitator-driven)	Deliberate Practice (Learner-driven)
Learners receive assessment before and after initial training.	The learner deliberately seeks out opportunities to practice because of a known or perceived deficit in their knowledge or skillset or perhaps just a desire to improve and reach a higher level of competency or expertise.
Facilitator creates targeted training plan to provide additional practice and remediation to those that require it, while providing additional practice to those who achieve the predetermined standard of proficiency. All learners receive ongoing feedback and coaching.	The learner determines explicit goal(s) for improving performance.
Learners are brought back to the learning environment for additional practice at regular intervals.	The learner engages in practice that may include multiple iterations and may occur in rapid succession (repetitive practice).
Learners receive assessment before and after each training experience. All learners receive ongoing feedback and coaching.	Feedback may be provided by another person and/or mechanical feedback, as with metrics provided by a simulator.
Remediation is provided to those that require it, while those achieving the predetermined standard of proficiency are provided additional practice until the greater mass (often described as 90%) of the learners achieve the intended goals.	Ongoing cycles of practice and feedback occur to assist the learner with reaching their goals.

Kardong-Edgren, 2012). Sometimes, the feedback and correction comes from another facilitator, but it can also come in the form of mechanical feedback, such as that provided by a cardiopulmonary resuscitation (CPR) simulator or ultrasound.

Returning to the example of central line placement, we find a practitioner who has mastered this skill. Reviewing their performance, we see that this practitioner consistently achieves high checklist marks over a period, has placed lines in actual patients under supervised practice, and went on to successfully place hundreds of lines on their own. Later, they find themselves in an instructor role, for this and many other skills. In their instructor role, they may not be placing many lines clinically and their curriculum plan may not require them to teach central line placement until the end of the year. As the time draws near for them to teach this skill to their learners, they reflect on their competency with placing lines and their reflection causes them to be concerned that they may not be 100% ready (Figure 2). Wishing to ensure that the learning session flows smoothly and accurately, they seek out opportunities to maintain expertise by refreshing their skills through practice. The provider-turned-instructor coordinates with the simulation facility for practice opportunities. *The act of seeking the practice after*

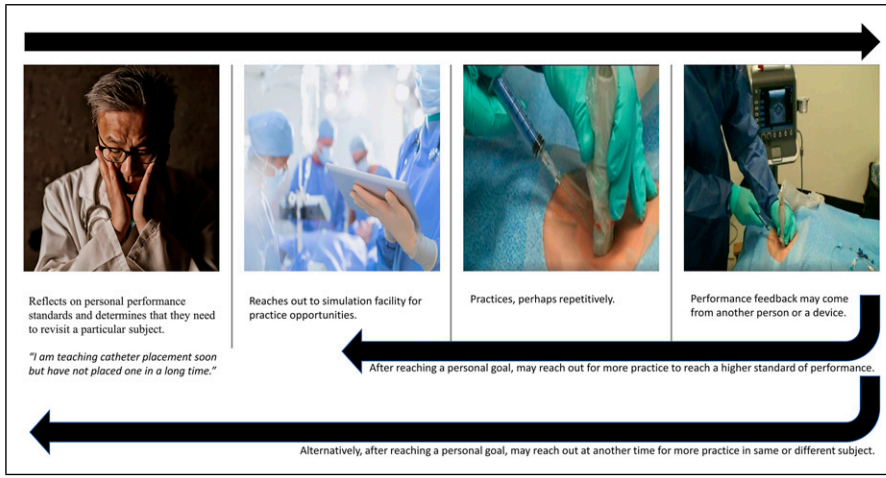

Figure 2. Deliberate practice.

realizing some actual or potential deficit in knowledge or skill is deliberate practice in action. What occurs in the simulation facility to achieve the higher standards of performance is practice.

Ericsson may have unintentionally created some of the confusion that simulationists are experiencing. Whereas his earlier work (Ericsson et al., 1993) focused on internal motivation and effort by the learner, some of his later work (Ericsson & Harwell, 2019) implied that a definition of deliberate practice needs to include the need for teachers/coaches to assess individual performance of trainees and recommend practice activities. What makes this confusing is that trainers can prepare a plan or provide resources for deliberate practice, but they cannot create internal motivation or effort in the learner. These are well-known psychology concepts that are learner-generated based on personal need, interest, and self-reflection (Clapper, 2014). In this article, the authors (Ericsson & Harwell) recognized that what they present as deliberate practice is defined by others as *structured practice* (Hüttermann et al., 2014; Macnamara et al., 2014). When I see or hear simulationists describe deliberate practice, too often it very well is described as structured practice. That is, facilitator driven and guided. Adding to the confusion, Krampe and Ericsson (1996) described practice to maintain acquired performance as *maintenance practice*, and later (Ericsson & Harwell, 2019) as *purposeful practice*.

Dictionary.com, 2022 defines the word deliberate, as:

"to think carefully or attentively; reflect":

She deliberated for a long time before giving her decision.

Thus, to assume that deliberate practice is something other than the learner reflecting and seeking out practice opportunities would not make much sense and spinning other names for it is defeating and creates greater confusion especially when we try to

implement it and define a set of research questions to study it. Deliberate practice is an important concept, and it truly matters that simulationists can name and align their practice accurately.

Moving through some challenges and making these concepts work

Bloom's mastery learning is based on the premise that we should not leave learners behind, by ensuring that they each reach a certain level of competency. This concept when applied according to its original intent with more than one session for each learner can be especially challenging when applied to clinical instruction. Nurses, medical students, and other healthcare providers have a tight curriculum to follow and there may not be much time in the schedule to allow for multiple sessions of practice and feedback for every task. Getting a small group of healthcare learners to simulation every week for an hour for five consecutive weeks to master an important skillset may be achievable. That is, if it does not violate duty hour restrictions and if they are interested and able to participate. With longer times (2–3 hours for chest tube, central line, and some other procedures) comes the higher risk of not accomplishing the task using a mastery learning approach. As Friederichs et al. (2019) observed, mastery learning is outcome based, not time based, and requires several demonstrations of competence and not just high performance demonstrated in a single session. In their research, Friederichs et al. found an increase in skill retention of peripheral venous catheters placed by medical students one year after training following a mastery learning model. In their research and instructional methods, the researchers accurately described and implemented mastery learning: "Assessments were performed at baseline and up to several times after training, until the mastery standard was achieved, and was accompanied by individualized assessment-based feedback" (p 541). However, they inaccurately attribute the practice that occurred in each session as deliberate practice which can confuse readers since the facilitators brought the medical students to their facility for the scheduled training sessions and provided teacher-directed practice.

Petrosoniak et al. (2019) also recognized that mastery learning may be difficult to regularly apply to a vast number of perishable healthcare-related skills. In their research, both mastery learning and deliberate practice are not described and implemented according to their original meanings: "Participants will perform each step under direct instructor observation in keeping with mastery learning techniques and subsequent practice will follow principles of deliberate practice – with the goal of skill improvement using repetitive performance coupled with personalized feedback from the instructor (p. 4) … The training session will be considered complete once the participant and instructor independently agree that competent skill performance is achieved" (p. 5). In this case, the research would be difficult to replicate as researchers could interpret the methods in different ways and this would be comparing apples to oranges. Still, the overlying theme remains that mastery learning especially when used correctly does in fact require much more time, due to several training sessions of repetitive practice and feedback that may be necessary. To make mastery learning work

1. Mastery learning *does not occur in a single session*, but rather over a period of weeks, months, or even years.
2. Deliberate practice can contain repetitive practice, but repetitive practice *is not* deliberate practice.
3. *We do not provide deliberate practice to our learners.* Our learners seek deliberate practice opportunities because of the *internal need* to refresh or improve.
4. Learners can practice several times in succession, even doing so rapidly, while receiving feedback. This is *repetitive practice*.

Figure 3. Key takeaways.

for busy healthcare providers, the first session may be required to be longer, while subsequent sessions may be shorter and to the point: assessment, practice, and feedback only as needed, and subsequent assessment.

Encouraging clinicians to deliberately reach out for practice opportunities based on a reflection of their level of competency in a particular area can also be a challenge. The imposter syndrome is present, and clinicians may feel that they could be one-step away from being exposed as the imposter they feel like sometimes (Brookfield, 1995, Clapper, 2010).

A provider approached me after a simulation session a few years ago and asked if he could stay so that he could practice with the central line bundle and ultrasound. Somewhere along the session, he (as with the physician mentioned earlier) felt that he had reached a high level of competency with the central line skills, but not the art of using the ultrasound to locate the vein. I was honored that he felt that I was an approachable facilitator and one that he could trust with this request. The fact that he was in a high leadership position was likely the reason why he also wanted to be out of sight of the others while he practiced on that skill. Being aware of that imposter syndrome, we may schedule the open practice sessions in locations that provide some privacy while practicing. Of course, this strategy requires providing a private space and resources to support their intentional, deliberate practice.

Certifications for healthcare simulation facilitators and operations personnel have existed for about 10 years now. Certification implies that an individual has obtained a certain standard of practice; however, that standard is a moving target if it is not based on a consistent definition or standards of practice. Likewise, as noted previously, research especially systemized reviews and meta-analysis are negatively affected by inconsistent and inaccurate description of the research methods and protocols. This makes it difficult for us to assess the impact of the strategies we use in healthcare simulation and know what strategies are working well and which ones are not. More importantly, there is the impact to learning. If we are to dedicate more time and resources to mastery learning and deliberate practice, we need to make sure that we are

getting it right. Training time is precious, and we must be able to justify a return on investment in the form of higher levels of competency in our learners.

As shown in Figure 3, there are some takeaways that simulationists need to learn. They might post these highlights somewhere where they can *deliberately* refresh when planning learning opportunities to ensure that they are applying mastery learning and deliberate practice in its purest form.

Conclusion

There is a saying that many PhD candidates learn very well. It varies in structure, but the meaning remains the same. Theory guides practice; practice guides research (author unknown). This statement is interchangeable and has a cyclical and a mutually complimentary pattern about it. The correct application of theory is important because research relies upon applying the rules and behaviors involved in a theory in a consistent manner to test its application to practice in a variety of domains. As noted by Newsome, 1964, "It is only by scientific research, not by philosophical analysis and speculation, that the practical usefulness of theory can be substantiated" (p. 64). Mastery learning and deliberate practice can guide much of our work in the simulation community, leading to robust returns of investment for the organization and the learners.

An accurate understanding of mastery learning and deliberate practice can ensure that going forward, we properly design interventions, systems, and research protocols that can inform us about what works best for our learners.

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