5-2022

More than a Meme: The Dunning-Kruger Effect as an Opportunity for Positive Change in Nursing Education

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Clinical Simulation in Nursing, Vol. 66, (May 2022): 58-65. DOI.

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Highlights

•DKE manifests as the difference between subjective and objective measurement.
•DKE is a type of response bias demonstrated by overestimation of skill.
•Metacognitive skills differ between over estimators and under estimators.
•Hypocognition is a prominent contributor to the presence of DKE.

•Subjective and objective assessment in tandem provides rich feedback opportunities.

Abstract

The Dunning–Kruger Effect (DKE) describes the cognitive bias in which novices tend to overestimate performance or competence while experts tend to underestimate. Those who are lacking in competence do not have the skills to accurately recognize deficient performance. Subjective assessment is used widely in simulation learning and in nursing curricula, yet often without expert feedback and reflective discussions, which can result in mistakes being overlooked and encoded, which could subsequently result in clinical errors. The prevalence of DKE should not be interpreted solely as a deprecation of the use of subjective measures, but rather as an indicator of the need for improving self-reflection, metacognition, and an opportunity for formative feedback.

Keywords

Measurement, Assessment, Self-report, Dunning-Kruger Effect, Formative Feedback

Key Points

•DKE is a type of response bias demonstrated by overestimation of skill.
•Subjective and objective assessment in tandem provide rich feedback opportunities.
•Hypocognition is a prominent contributor to the presence of DKE

Introduction

The Dunning-Kruger Effect (DKE) describes an ironic paradox that is evident when individuals overestimate their competence in a specific behavior, skill, or domain; whereas those who are more skilled tend to underestimate their competence (Kruger, 1999). Social media and popular news outlets are increasingly highlighting DKE in a negative but humorous fashion with memes and political cartoons, yet this phenomenon is not merely a GIF to be shared but poses a critical threat to the validity of education and research in the social sciences. For nurse educators, simulationists, students, and researchers, a failure to understand DKE as a type of cognitive bias leads to serious limitations for studies using instruments relying solely on self-assessment. Most importantly, acknowledging the potential for DKE presents a rich opportunity for meaningful feedback discussions while learning and improving any skill.

The DKE manifests as the difference between subjective and objective measurement. Because of the increased prevalence of DKE in recent literature reporting research and education, , the authors sought to understand this phenomenon byexploring the contributing variables. The purpose of this paper is to present the resulting overview of DKE in the context of subjective and objective measurement, while charging educators, simulationists, and researchers to acknowledge and consider the implications of DKE in their work.

Subjective and Objective Measurement

A scientific goal of measurement is accuracy for both the instrument itself and its' user (Girard & Cohn, 2016; Vener, Wichnick-Gillis, & Poulson, 2017). Accuracy is rarely achieved perfectly, even in blinded objective measurement, and much less when data is generated by individuals making self-judgments about their individual skills, behaviors, and abilities (Kahneman, Sibony, & Sunstein, 2021). Judgment in the context of measurement refers both to the mental activity of arriving at a conclusion as well as the outcome of that judgment. Measurement tools used to gather objective or subjective data, commonly referred to as instruments or tools, are used when collecting data describing behaviors, skills, performance, and experiences (Santomauro, Hill, McCurdie, & McGlashan, 2020). The use of well-tested instruments standardizes observations to remove subjectivity, minimizing the response biases inherent to self-assessment measures (Girard &

Cohn, 2016). When used correctly, these tested instruments can provide data driven feedback to improve the behavior or skill of measurement (Santomauro et al., 2020).

Subjective and objective measures each have value as well as challenges, requiring researchers to carefully consider which type of instrument is an appropriate measure of the variable of interest (Vener et al., 2017). Objective measurement is widely accepted as a scientific, systematic approach to detect, interpret, and understand behavior, allowing for direct observation of a behavior as it occurs within the natural context (Girard & Cohn, 2016; Vener et al., 2017). Observational methods require raters who are trained to identify the attributes of the behavior or skill to make objective, quantitative judgments using an instrument that reliably measures that skill or behavior (Girard & Cohn, 2016). While expert observers support increased measurement objectivity, this approach can be resource intensive and is not always feasible.

Alternatively, subjective instruments are designed for participants to self-assess their behavior, skill, or variable of interest. However, it is difficult for an individual to limit their assessment to one isolated instance of performance, influencing how they perceive they typically behave in that specific domain, thus creating challenges for measurement at multiple time points to show differences or improvement (Dang, King, & Inzlicht, 2020). Although the limitations of subjective data have been widely acknowledged, self-report remains common because it can provide valuable insights leading to self-motivated improvement. However, the response bias resulting from unintentional subconscious efforts to preserve self and inflate abilities can limit the validity and usefulness of self-reported data (Rosenman, Tennekoon, & Hill, 2011). One example of response bias is DKE, which poses a considerable threat to the validity of data.

The Dunning-Kruger Effect

Throughout history, self-assessment of skill performance has presented an intriguing phenomenon full of irony, known as the Socratic paradox "…it is likely that neither of us knows anything worthwhile, but …I do not think I know what I do not know" (Bowden, Jung-Beeman, Fleck, & Kounios, 2005). In nursing education, Nancy Diekelmann, a pioneer of nursing education reform, summarized this phenomenon by frequently quipping "you only know what you know, and you don't know what you don't know…don't you know?" (Diekelmann & Diekelmann, 2009, pg. 85) Kruger and Dunning (1999). first reported DKE following a series of studies in which participants were evaluated on humor (social ability), logical reasoning (intellectual ability), and English grammar (level of knowledge). Participants who scored the lowest on tests of logical reasoning, grammar, and sense of humor demonstrated the most overestimation of their skills; believing they outperformed more than 52% of their peers, instead of the actual 12%. These findings led Kruger and Dunning (1999) to propose that individuals who are less competent in a domain 1) tend to overestimate their performance, 2) are unable to identify expert levels in others, 3) fail to recognize how little they know of the skill, behavior, or domain, and 4) eventually recognize their lack of skill when trained to improve Kruger and Dunning (1999). further posited that a double burden exists for those lacking competence in a specific domain because they also lack the ability to accurately recognize their incompetence; the skills required to demonstrate competence are the same skills required to assess it. Those who are unskilled are also likely to be unaware of how unskilled they are, and thus more likely to overestimate their competence.

Over the two decades since their initial findings, Kruger and Dunning's (1999) work has been cited across many domains more than 15,000 times. Their propositions have been replicated repeatedly, demonstrating widespread prevalence as depicted by a sample of research reports in Table 1. While DKE has been attributed to statistical artifact or a form of regression to the mean (Feld, Sauermann, & De Grip, 2017; Gignac & Zajenkowski, 2020; McIntosh, Fowler, Lyu, & Della Sala, 2019), the mounting evidence suggests individuals may not accurately judge their own abilities. Nuhfer and colleagues (2016, 2017) hypothesized that quantifying the ability to self-assess accurately is measurable and can be answered with a simple calculation of the difference

between a self-rating and an observational rating, thereby demonstrating a DKE gap. As such, DKE explains the gap between subjective and objective assessment (Gibbs, Moore, Steel, & McKinnon, 2017). While this calculation seems straightforward, mitigating DKE is multi-faceted because it is underpinned by several interconnected variables.

Table 1. Reports of the Presence of DKE in Research

Domain	**Author(s)**
Autism awareness	(Motta, Callaghan, & Sylvester, 2018)
Coaching efficacy	(Sullivan, Ragogna, & Dithurbide, 2019)
Competitive bridge players	(Simons, 2013)
Evidence-based practice knowledge, skills, attitudes	(Hagedorn Wonder et al., 2017)
Emotional/facial expression recognition abilities	(Boz & Erdogan, 2019)
Estimating levels of bias	(West & Eaton, 2019)
Financial literacy	(Balasubramnian & Sargent, 2020)
Grammar test, literature knowledge, nanotechnology knowledge	(Plohl & Musil, 2018)
Inductive reasoning	(Coutinho et al., 2020)
Mechanical ventilation care	(Acho, Seam, & Lee, 2019)
Memory tasks	(Muller et al., 2019)
Movement and memory task	(McIntosh et al., 2019)
Political knowledge	(Anson, 2018)
Psychology research methods	(Guillory & Blankson, 2017)
Second language speech learning	(Saito, Trofimovich, Abe, & In'nami, 2020)
Self-assessed intelligence and objectively measured IQ	(Gignac & Zajenkowski, 2020)
Self-medicating practice among medical students	(Acharya, Dixit, & Ghimire, 2019)
Shipboard navigation	(Bury, Saeed, & Khalique, 2020)
Social privilege	(Wu & Dunning, 2020)
Sports coaching	(Sullivan et al., 2019)
Surgical training for cholecystectomy	(Ahmed & Walsh, 2020)
Surgical knot tying	(Wang et al., 2020)
Wine knowledge	(Aqueveque, 2018)
Vocabulary, logical reasoning, and humor	(Bunay et al., 2018)
Workplace computing	(Gibbs et al., 2017)

Understanding the DKE Gap

It is important to first understand the underlying variables that contribute to DKE before determining how to lessen the assessment gap between self and an expert. The overestimation of skill represented by DKE is a type of response bias, which is the systematic tendency to respond, or assess, with inaccurate or misleading self-ratings (Paulhus & Dubois, 2014). Response bias is demonstrated by DKE with competence overestimation because of the subconscious effort to preserve and promote self (Anson, 2018). There are other similar types of response biases, including socially desirable responding, which is the tendency toward overly positive self-descriptions that are perceived as more socially acceptable (Bensch, Paulhus, Stankov, & Ziegler, 2019; Paulhus & Dubois, 2014). Overconfidence is another human tendency response bias manifested by a positive distortion between perceived and actual performance based on feelings of confidence (Bensch et al., 2019; Coutinho, Thomas, Lowman, & Bondaruk, 2020).

Workaround, or reach-around, knowledge (Dunning, 2011; Muller, Sirianni, & Addante, 2019; Wu & Dunning, 2018) is a response bias in which knowledge and experience gained from previous similar experiences is generalized and transferred to the current experience even though it is not the exact same experience. When

individuals recognize they have no knowledge yet there is some familiarity, there is a tendency to reach around that knowledge and build an intellectual scaffolding of thoughts that do not constitute actual expertise, piecing together unrelated or partially correct fragments of knowledge to come to a plausible, yet erroneous conclusion (Paulhus & Dubois, 2014). Each of these biases unknowingly compensates for lower levels of skill leading to taken-for-granted assumptions, misinterpretations, and inaccurate judgments (Dunning, 2011).

Metacognition

Because DKE explains that overestimation of knowledge and abilities stems from a lack of self-awareness, Dunning and Kruger (1999) further hypothesized that this lack of awareness of true competence was attributed to a mismatch between task performance, judgmental accuracy, and metacognition. Building on this hypothesis, further research has supported that the inability to accurately self-assess competence is due in part to undeveloped metacognitive skills (Boz & Erdogan, 2019; Coutinho et al., 2020; Nuhfer, Fleisher, Cogan, Wirth, & Gaze, 2017; Rosenman et al., 2011). The ability to accurately self-assess is a valuable metacognitive skill (Kruger & Dunning, 1999; Nuhfer et al., 2017) that relies on self-reflection to assess one's ability to self-regulate and improve (Rosenman et al., 2011). Metacognition involves multiple cognitive skills that support thinking about and controlling our thinking. It involves self-awareness of cognitive processes and thinking patterns (Schuster, Stebner, Leutner, & Wirth, 2020), a complex process that is developed through self-focus, self-evaluation, reflection, and feedback (Carden, Jones, & Passmore, 2021). Metacognition is critical to the learning process because it is central to the cognitive awareness of what and how one is learning (Guillory & Blankson, 2017).

Differences in the metacognitive skills of over estimators and under estimators have been exhibited in empirical studies across various domains; over estimators demonstrated unawareness of their lack of metacognitive skill, while under estimators were able to self-assess more accurately yet still underestimated their skills (Acosta, Smith, & Kreinovich, 2020; Boz & Erdogan, 2019; Bunay, Siguenza, Flores, & Serpa-Andrade, 2018; Coutinho et al., 2020; Mahmood, 2016; Pennycook, Ross, Koehler, & Fugelsang, 2017). Additionally, there are differences in the cognitive processes used when self-assessing (Muller et al., 2019). Over estimators tend to rely more on familiarity rather than recollection, which is an important component of reflection that requires retrieving the episodic event. If a memory is retrieved through familiarity rather than recollection, specific information will not be precisely recalled, and the item is retrieved without the associated accurate context (Wu & Dunning, 2018). Recollection of episodic events stored in memory plays a significant role in reasoning as well as how individuals metacognitively judge themselves, therefore accurate decision-making and retrospective self-evaluation may improve when not relying on familiarity and intuition. Rather, intentionally slowing the process of making judgments through the cognitive process of recollection of details yields more accurate self-assessments (Muller et al., 2019). However, this is not possible if there are no episodic events stored in memory and there is limited knowledge to be recollected, leading to hypo cognition.

Hypocognition

Hypocognition is a prominent contributor to DKE, which is the lack of a cognitive or linguistic representation of a concept resulting from the absence of schemata (Wu & Dunning, 2018, 2020). Schemata are the knowledge structures that represent a concept; if schemata are lacking, the ability to recall, reflect on, and interpret an experience is limited (Wu & Dunning, 2020). Without schemata, necessary cognitive associations cannot be made, and newly learned concepts cannot be connected to known concepts. This leads to the inability to notice important and specific details, a process that differentiates novices from experts (Dickison, Haerling, & Lasater, 2019). A novice nurse can only think and behave within the boundaries of what they know; outside of their cognitive boundaries, they exhibit hypocognition (Wu & Dunning, 2018). Novice nurses assimilate and accommodate new nursing knowledge into existing schemata, or frameworks of conceptual knowledge, as they

develop cognitive processes. Because these cognitive processes are built in a scaffolding manner, hypocognition gradually decreases, becoming less of a cognitive blind spot over time (Wu & Dunning, 2020).

Previously acquired conceptual knowledge is important to lessening hypocognition because encoding new knowledge and understanding is built on these existing knowledge structures by organizing what is experienced and observed, which supports memory. Since encoding processes occur automatically, hypocognition can disrupt and inhibit this process, further limiting the ability to retain and recall necessary information accurately (Wu & Dunning, 2018). The relationship between hypocognition, existing schemata, and naturally occurring encoding processes explains how and why there is a greater tendency toward error in self-assessing. The lack of conceptual knowledge and the limited ability to encode data into memory impacts the ability to recall and recognize specific details of a newly learned skill or newly acquired knowledge. This inhibits the ability to accurately self-analyze and self-assess skill level.

Although hypocognition is initially invisible to those who exhibit it (Dunning, 2011; Wu & Dunning, 2018), intellectual humility and motivation to learn can foster the transition from hypocognition to increased metacognition. Importantly, metacognitive abilities have been found to improve when more knowledge and experience is acquired in a specific skill or task (McIntosh et al., 2019; Stojiljković, Bozilov, Golubovic, Glisovic, & Cvetkovic, 2018), As such, metacognition is not static, but is dynamic and can be improved by expanding knowledge and experiences, in tandem with improving self-reflection (Persky, Lee, & Schlesselman, 2020). This is integral to mitigating DKE: as metacognition increases, hypocognition decreases, thereby bridging the subjective-objective measurement gap.

Bridging the DKE Gap

Implications for Nursing Educators and Simulationists

DKE is not unfamiliar to learners, educators, or simulationists. Rather, it is likely that regardless of role, most have been in a situation either defaulting to one of these biases as a defense mechanism in the face of critique, or subjectively self-rating knowledge, skills, or behaviors without receiving objective feedback to verify accuracy. Overestimation of competence and remaining unaware of this is common among novices, whether the novice is a student or a new educator. Nurse educators continually assimilate new teaching-learning skills into existing pedagogical knowledge, and intentionally accommodate new skills into individual teaching-learning frameworks. Currently, there is a targeted focus on the ability of nurse educators to teach and assess clinical judgment among students. Not only is clinical judgment a focus of measurement with the impending revised nursing licensure exam (Dickison et al., 2019), it is a highly complex thinking skill required of nurses in practice. The downstream effects of a less than competent educator could be detrimental to nursing students, and ultimately jeopardize patient safety. Therefore, it is imperative for nurse educators to embrace life-long learning and intellectual humility, fully aware of the innate tendency toward positive self-bias.

When learning and self-assessing new teaching-learning skills, educators are presented with an opportunity to improve the capacity to self-reflect and engage in metacognition. Peer assessment is important to this process but requires a peer who is more expert in the skill and is qualified to reliably rate with an objective instrument (Bradley, Johnson, & Dreifuerst, 2021; Cheng et al., 2017; Saylor, Wainwright, Herge, & Pohlig, 2016). Peers who do not have expertise to reliably assess skill may default to reach-around knowledge biases that will halt learning and create a false sense of competence, which could ultimately lead to errors. An expert rater will provide the opportunity for the learner to self-calibrate when comparing a self-rating with an expert rating of that skill. Recognizing what remains unknown is critical to the learning process, requiring feedback from an expert to identify needs (Bradley et al., 2021; Cheng et al., 2017; Ehrlinger, Mitchum, & Dweck, 2016; Fey, Auerbach, & Szyld, 2020).

As simulationists, professional development is foundational to developing, facilitating, and evaluating simulation learning experiences. Professional organizations including the Society for Simulation in Healthcare, the Association for Standardized Patient Educators (Lewis et al., 2017), the National Council of State Boards of Nursing (Alexander et al., 2015), and the National League for Nursing (NLN Board of Governors, 2015) all recommend training and ongoing development of educators with assessment of competence. Each of these organizations is aligned with the Healthcare Standards of Best Practice™ Professional Development that identifies the value of self-assessing educational needs, participating in needed professional development activities, then reevaluating the professional development plan using formative and summative assessment (Hallmark et al., 2021). Awareness of the prevalence of DKE can prepare simulationists to balance their self-assessment of simulation and debriefing skills with feedback from more expert simulationists.

Implications for Nursing Students

Subjective assessment is used widely across nursing curricula, including simulation learning, but often without expert feedback and reflective discussions. Unrecognized DKE can result in unrecognized student mistakes that may be subsequently encoded in short-term and long-term memory, resulting in clinical errors because they are unable to recognize their deficits (Guillory & Blankson, 2017). If students do not know the extent to which they are lacking in knowledge or skills, their learning and clinical application of nursing knowledge can be hindered because they will not recognize a need for improvement (Coutinho, Thomas, Alsuwaidi, & Couchman, 2021; Ehrlinger et al., 2016).

Nurse educators can ensure that students learn to self-assess their knowledge and skills in tandem with objective assessment from expert instructors, including opportunities for formative feedback and re-training as necessary (Ahmed & Walsh, 2020; Cheng et al., 2020). Comparing subjective and objective data from self, peers, and instructors can help a novice learn to re-calibrate their thinking about their own skill level, leading to more accurate assessment of their competence levels (Nuhfer, Cogan, Fleisher, Gaze, & Wirth, 2016; Pennycook et al., 2017). By intentionally addressing any DKE gap, students can learn to balance their self-assessment with an objective assessment, which also ensures that their actual observed skill level is recognized at that specific point in time (Ahmed & Walsh, 2020). In addition, if students are not aware of their ineffective learning strategies, acknowledging the DKE gap can help students learn to make changes in their studying and learning habits (Guillory & Blankson, 2017).

As nursing education shifts to competency-based education and assessment, an understanding of the influence of DKE and the importance of students developing metacognitive skills is crucial. The ability of students to self-monitor what they currently know and what they still need to learn requires metacognitive skills that are foundational to achieving nursing competence (Guillory & Blankson, 2017). It is imperative to engage students in interactive and dynamic conversations that model recollection and reflection, while facilitating student self-reflection. Purposely focusing teaching and learning on the ability to self-reflect equips students to improve future performance, encourages clinical judgment, and facilitates internal motivation (Wang et al., 2020). To successfully facilitate competency-based learning, students need ample repeated opportunities for practice to improve knowledge and skills while scaffolding application of that learning to numerous contexts and patient conditions. In this manner, competence reflects contextual and authentic application of learning into nursing practice.

In their original studies, Dunning and Kruger (1999) found that when over estimators were asked to rate others and then re-rate themselves, the over estimators were not able to accurately rate their peers' competence, nor did they gain insight into their own level of competence by directly observing more expert performances. This has been substantiated in other studies including psychology students (Bunay et al., 2018), in assessing emotional intelligence (Boz & Erdogan, 2019), and among college science and math students after receiving

expert feedback (Erat, Demirkol, & Sallabas, 2020). Alternatively, there is a growing body of research demonstrating that skill level improves after observing experts (Aqueveque, 2018; Ehrlinger et al., 2016), warranting additional exploration. Positive learning outcomes from observational protocols have also been demonstrated in simulation pedagogy (Welsher et al., 2018) and clinical skills training (Domuracki, Wong, Olivieri, & Grierson, 2015). Importantly, a key feature to these findings is the advancing science of mirror neuron cognitive function and brain-based learning, which included the use of novice and expert feedback in tandem.

Implications for Researchers

The extant nursing clinical and simulation research literature is replete with research reports describing the use of subjective instruments, yet it is rare to find DKE noted as a limitation. Ensuring that outcome measures do not rely solely on perception or self-confidence but also include an objective assessment could mitigate DKE and strengthen the validity of results. As the body of simulation research continues to grow, fewer studies with only subjective measures are a desirable goal because of the serious limitation of a DKE threat to validity.

As researchers and educators, it is vital to accept that confidence is not a reliable predictor of competence (Erat et al., 2020; Mahmood, 2016). Confidence is a feeling of self-assurance of one's ability, based on self-perception. This may not necessarily reflect actual learning, however, and as such is a more suitable measure of self-efficacy rather than ability (Persky et al., 2020). According to Kirkpatrick's evaluation model (Kirkpatrick & Kirkpatrick, 2016), perception is the lowest form of learning. Despite this, perception and confidence are frequently self-assessed in education and research without triangulation with other measures (Persky et al., 2020). The overwhelming number of studies reported in clinical and simulation literature that measure confidence as an outcome of learning is concerning. In the presence of DKE, confidence privileges assimilation and marginalizes accomodation, leading the unskilled and unaware into the trap of unconsciously making assumptions or mistakes. Metacognitive skills can alleviate unwarranted confidence, yet this requires learning to reflect on thinking and on ability, which takes time and practice to develop.

Conclusion

The Dunning-Kruger Effect is a phenomenon in which individuals are unable to accurately self-assess, resulting in an overestimation of their abilities. When learning new skills that require judgment, reasoning, and higher order thinking, acknowledging the importance of teaching and learning how to accurately self-assess and self-reflect is a call to action. Further, teaching-learning methods that integrate self-assessment with objective assessment followed by a feedback dialogue can mitigate many of the contributing factors of DKE while also developing strong reflective practitioners in health science disciplines. Most importantly, an awareness and understanding of DKE, a frequent subject of negativity and humor, provides rich opportunities for enacting strong pedagogy and rigorous research design. The prevalence of DKE should not be interpreted solely as a deprecation of the use of subjective measures, but rather as an indicator of the need for including objective assessment, self-reflection, metacognition, and formative feedback in future learning and research activities.

The authors acknowledge they are not immune to DKE but are seeking to learn more about this phenomenon and explore how it can not only be mitigated but used to strengthen self-improvement. Truly, DKE is about each person knowing themselves and recognizing the potential to demonstrate DKE at any time in a variety of skills and behaviors. Therefore, every educator, researcher, and simulationist is charged to vigilantly embrace intellectual humility. Recognizing the gap between what is currently known and exposing what has not yet been learned is the first giant leap towards a lifetime of learning.

Financial Disclosures

This work was supported by the Office of the Vice President for Research, University of Minnesota, Minneapolis, MN.

Declarations of Interest

None

References

Acharya et al., 2019 J. Acharya, S.M. Dixit, S. Ghimire. **Self medication among undergraduate medical students: an alarming concern of "over the counter" drugs in Nepal** Nepal Medical Journal, 2 (2) (2019), pp. 33-36, 10.37080/nmj.67

Acho et al., 2019 M. Acho, N. Seam, B. Lee. **Balancing confidence and competence: the dunning-kruger effect among critical care fellows enrolled in a mechanical ventilation course**A33. Advances In Medical Education in Pulmonary and Critical Care Medicine, American Thoracic Society (2019) (pp. A1350-A1350)

Acosta et al., 2020 G. Acosta, E. Smith, V. Kreinovich. **Analytical techniques for gauging accuracy of expert knowledge: a simple system-based explanation of the dunning–kruger effect** Springer International Publishing (2020), pp. 27-32, 10.1007/978-3-030-46413-4_6

Ahmed and Walsh, 2020 O. Ahmed, T.N. Walsh. **Surgical trainee experience with open cholecystectomy and the dunning-kruger effect** Journal of Surgical Education, 77 (5) (2020), pp. 1076-1081, 10.1016/j.jsurg.2020.03.025

Alexander et al., 2015 M. Alexander, C.F. Durham, J.I. Hooper, P.R. Jeffries, N. Goldman, S.S. Kardong-Edgren, K.S. Kesten, N. Spector, E. Tagliareni, B. Radtke, C. Tillman. **NCSBN Simulation guidelines for prelicensure nursing programs** Journal of Nursing Regulation, 6 (3) (2015), pp. 39-42, 10.1016/s2155-8256(15)30783-3

Anson, 2018 I.G. Anson. **Partisanship, political knowledge, and the dunning-kruger effect** Political Psychology, 39 (5) (2018), pp. 1173-1192, 10.1111/pops.12490

Aqueveque, 2018 C. Aqueveque. **Ignorant experts and erudite novices: exploring the dunning-kruger effect in wine consumers** Food Quality and Preference, 65 (2018), pp. 181-184, 10.1016/j.foodqual.2017.12.007

Balasubramnian and Sargent, 2020 B. Balasubramnian, C.S. Sargent. **Impact of inflated perceptions of financial literacy on financial decision making** Journal of Economic Psychology, 80 (October 2020) (2020), pp. 1-16, 10.1016/j.joep.2020.102306 102306

Bensch et al., 2019 D. Bensch, D.L. Paulhus, L. Stankov, M. Ziegler. **Teasing apart overclaiming, overconfidence, and socially desirable responding** Assessment, 26 (3) (2019), pp. 351-363, 10.1177/1073191117700268

Bowden et al., 2005 E.M. Bowden, M. Jung-Beeman, J. Fleck, J. Kounios. **New approaches to demystifying insight** Trends in Cognitive Sciences, 9 (7) (2005), pp. 322-328

Boz and Erdogan, 2019 H. Boz, K. Erdogan. **Service quality, emotion recognition, emotional intelligence and Dunning Kruger syndrome** Total Quality Management (2019), pp. 1-14, 10.1080/14783363.2019.1686971

Bradley et al., 2021 C.S. Bradley, B.K. Johnson, K.T. Dreifuerst. **Psychometric properties of the revised DML evaluation scale: a new instrument for assessing debriefers** Clinical Simulation in Nursing, 56 (2021), pp. 99-107, 10.1016/j.ecns.2021.04.008

Bunay et al., 2018 R. Bunay, W. Siguenza, K. Flores, L. Serpa-Andrade. **Impact of the dunning kruger effect on psychology students at the university of Cuenca** Advances in Human Factors in Training, Education, and Learning Sciences (2018), pp. 383-391, 10.1007/978-3-319-60018-5_37

Bury et al., 2020 A. Bury, F. Saeed, A. Khalique. **Simulator-based learning, the dunning-kruger effect and the newly-'qualified'Officer of the Watch** Seaways: The International Journal of The Nautical Institute (2020), 10.1145/3375900.3375918

Carden et al., 2021 J. Carden, R.J. Jones, J. Passmore. **Defining self-awareness in the context of adult development: a systematic literature review** Journal of Management Education (2021), Article 105256292199006, 10.1177/1052562921990065

Cheng et al., 2020 A. Cheng, W. Eppich, M. Kolbe, M. Meguerdichian, K. Bajaj, V. Grant. **A conceptual framework for the development of debriefing skills: A journey of discovery, growth, and maturity** Simulation in Healthcare, 15 (1) (2020), pp. 55-60

Cheng et al., 2017 A. Cheng, V. Grant, J. Huffman, G. Burgess, D. Szyld, T. Robinson, W. Eppich. **Coaching the debriefer: Peer coaching to improve debriefing quality in simulation Programs** Simulation in Healthcare, 12 (5) (2017), pp. 319-325, 10.1097/SIH.0000000000000232

Coutinho et al., 2021 M.V. Coutinho, J. Thomas, A.S. Alsuwaidi, J.J. Couchman. **Dunning-Kruger Effect: Intuitive errors predict overconfidence on the Cognitive Reflection Test** Frontiers in Psychology, 12 (2021), p. 1040

Coutinho et al., 2020 M.V. Coutinho, J. Thomas, I.F. Lowman, M.V. Bondaruk. **The dunning-kruger effect in emirati college students: Evidence for generalizability across cultures** International Journal of Psychology and Psychological Therapy, 20 (1) (2020), pp. 29-36

Dang et al., 2020 J. Dang, K.M. King, M. Inzlicht. **Why are self-report and behavioral measures weakly correlated?** Trends in Cognitive Sciences, 24 (4) (2020), pp. 267-269, 10.1016/j.tics.2020.01.007

Dickison et al., 2019 P. Dickison, K.A. Haerling, K. Lasater. **Integrating the national council of state boards of nursing clinical judgment model into nursing educational frameworks** Journal of Nursing Education, 58 (2) (2019), pp. 72-78

Diekelmann and Diekelmann, 2009 Diekelmann, J., & Diekelmann, N. (2009). *Schooling learning teaching: Toward narrative pedagogy*. iUniverse.

Domuracki et al., 2015 K. Domuracki, A. Wong, L. Olivieri, L.E.M. Grierson. **The impacts of observing flawed and flawless demonstrations on clinical skill learning** Medical Education, 49 (2) (2015), pp. 186-192, 10.1111/medu.12631

Dunning, 2011 D. Dunning. **The Dunning–Kruger Effect: On being ignorant of one's own ignorance** Advances in Experimental Social Psychology, 44, Elsevier (2011), pp. 247-296, 10.1016/b978-0-12-385522-0.00005-6

Ehrlinger et al., 2016 J. Ehrlinger, A.L. Mitchum, C.S. Dweck. **Understanding overconfidence: Theories of intelligence, preferential attention, and distorted self-assessment** Journal of Experimental Social Psychology, 63 (2016), pp. 94-100, 10.1016/j.jesp.2015.11.001

Erat et al., 2020 S. Erat, K. Demirkol, M.E. Sallabas. **Overconfidence and its link with feedback** Active Learning in Higher Education, 2020 (2020), pp. 1-15, 10.1177/1469787420981731

Feld et al., 2017 J. Feld, J. Sauermann, A. De Grip. **Estimating the relationship between skill and overconfidence** Journal of Behavioral and Experimental Economics, 68 (2017), pp. 18-24

Fey et al., 2020 M.K. Fey, M. Auerbach, D. Szyld. **Implementing faculty development programs: Moving from theory to practice** Simulation in Healthcare, 15 (1) (2020), pp. 5-6, 10.1097/SIH.0000000000000429

Gibbs et al., 2017 S. Gibbs, K. Moore, G. Steel, A. McKinnon. **The dunning-kruger effect in a workplace computing setting** Computers in Human Behavior, 72 (2017), pp. 589-595, 10.1016/j.chb.2016.12.084

Gignac and Zajenkowski, 2020 G.E. Gignac, M. Zajenkowski. **The Dunning-Kruger effect is (mostly) a statistical artefact: Valid approaches to testing the hypothesis with individual differences data** Intelligence, 80 (2020), 10.1016/j.intell.2020.101449

Girard and Cohn, 2016 J.M. Girard, J.F. Cohn. **A Primer on observational measurement** Assessment, 23 (4) (2016), pp. 404-413, 10.1177/1073191116635807

Guillory and Blankson, 2017 J.J. Guillory, A.N. Blankson. **Using recently acquired knowledge to self-assess understanding in the classroom** Scholarship of Teaching and Learning in Psychology, 3 (2) (2017), p. 77

Hagedorn Wonder et al., 2017 A. Hagedorn. Wonder, A.M. McNelis, D. Spurlock Jr., P.M. Ironside, S. Lancaster, C.R. Davis, N. Verwers. **Comparison of Nurses' self-reported and objectively measured evidence-based practice knowledge**The Journal of Continuing Education in Nursing, 48 (2) (2017), pp. 65-70, 10.3928/00220124-20170119-06

Hallmark et al., 2021 B. Hallmark, M. Brown, D.T. Peterson, M. Fey, S. Decker, E. Wells-Beede, T. Britt, L. Hardie, C. Shum, H.P. Arantes, M. Charnetski, C. Morse. **Healthcare simulation standards of best PracticeTM professional development** Clinical Simulation in Nursing, 58 (2021), pp. 5-8, 10.1016/j.ecns.2021.08.007

Kahneman et al., 2021 D. Kahneman, O. Sibony, C.R. Sunstein. **Noise: A flaw in human judgment** Little, Brown (2021)

Kirkpatrick & Kirkpatrick, 2016 J.D. Kirkpatrick, W.K. Kirkpatrick. *Kirkpatrick's four levels of training evaluation*, Association for Talent Development, Alexandria (2016)

Kruger, 1999 J. Kruger. **Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments** Journal of Personality and Social Psychology, 77 (6) (1999), pp. 1121-1134 https://doi.org/https://doi.org/10.1037/0022-3514.77.6.1121

Kruger and Dunning, 1999 J. Kruger, D. Dunning. **Unskilled and unaware of it: How difficulties in recognizing one's own incompetence lead to inflated self-assessments** Journal of Personality and Social Psychology, 77 (6) (1999), pp. 1121-1134, 10.1037/0022-3514.77.6.1121

Lewis et al., 2017 K.L. Lewis, C.A. Bohnert, W.L. Gammon, H. Hölzer, L. Lyman, C. Smith, ..., G. Gliva-McConvey. **The association of standardized patient educators (ASPE) standards of best practice (SOBP)** Advances in Simulation, 2 (1) (2017), pp. 1-8, 10.1186/s41077-017-0043-4

Mahmood, 2016 K. Mahmood. **Do people overestimate their information literacy skills? a systematic review of empirical evidence on the dunning-kruger effect** Communications in Information Literacy, 10 (2) (2016), pp. 198-213, 10.15760/comminfolit.2016.10.2.24

McIntosh et al., 2019 R.D. McIntosh, E.A. Fowler, T. Lyu, S. Della Sala. **Wise up: clarifying the role of metacognition in the dunning-kruger effect** Journal of Experimental Psychology: General, 148 (11) (2019), pp. 1882-1897, 10.1037/xge0000579

Motta et al., 2018 M. Motta, T. Callaghan, S. Sylvester. **Knowing less but presuming more: Dunning-Kruger effects and the endorsement of anti-vaccine policy attitudes** Social Science & Medicine, 211 (2018), pp. 274-281, 10.1016/j.socscimed.2018.06.032

Muller et al., 2019 A. Muller, L.A. Sirianni, R.J. Addante. **Neural correlates of the dunning-kruger effect** European Journal of Neuroscience, 53 (2) (2019), pp. 460-484, 10.1111/ejn.14935

National League for Nursing Board of Governors 2015. National League for Nursing Board of Governors, (2015). Debriefing across the curriculum: A living document from the national league for nursing in collaboration with the international nursing association for clinical simulation and learning.

Nuhfer et al., 2016 E. Nuhfer, C. Cogan, S. Fleisher, E. Gaze, K. Wirth. **Random number simulations reveal how random noise affects the measurements and graphical portrayals of self-assessed competency** Numeracy: Advancing Education in Quantitative Literacy, 9 (1) (2016), pp. 1-24, 10.5038/1936-4660.9.1.4

Nuhfer et al., 2017 E. Nuhfer, S. Fleisher, C. Cogan, K. Wirth, E. Gaze. **How random noise and a graphical convention subverted behavioral scientists' explanations of self-assessment data: Numeracy underlies better alternatives** Numeracy: Advancing Education in Quantitative Literacy, 10 (1) (2017), pp. 1-31, 10.5038/1936-4660.10.1.4

Paulhus and Dubois, 2014 D.L. Paulhus, P.J. Dubois. **Application of the overclaiming technique to scholastic assessment** Educational and Psychological Measurement, 74 (6) (2014), pp. 975-990, 10.1177/0013164414536184

Pennycook et al., 2017 G. Pennycook, R.M. Ross, D.J. Koehler, J.A. Fugelsang. **Dunning-Kruger effects in reasoning: Theoretical implications of the failure to recognize incompetence** Psychonomic Bulletin & Review, 24 (6) (2017), pp. 1774-1784, 10.3758/s13423-017-1242-7

Persky et al., 2020 A.M. Persky, E. Lee, L.S. Schlesselman. **Perception of learning versus performance as outcome measures of educational research** American Journal of Pharmaceutical Education, 84 (7) (2020), pp. 993-1000

Plohl and Musil, 2018 N. Plohl, B. Musil. **Do I know as much as I think i do? The dunning-kruger effect, overclaiming, and the illusion of knowledge** Psihološka obzorja /Horizons of Psychology, 27 (2018), pp. 20-30, 10.20419/2018.27.481

Rosenman et al., 2011 R. Rosenman, V. Tennekoon, L.G. Hill. **Measuring bias in self-reported data** International Journal of Behavioural and Healthcare Research, 2 (4) (2011), pp. 320-323, 10.1504/ijbhr.2011.043414

Saito et al., 2020 K. Saito, P. Trofimovich, M. Abe, Y. In'nami. **Dunning-Kruger effect in second language speech learning: How does self perception align with other perception over time?** Learning and Individual Differences, 79 (2020), pp. 1-10, 10.1016/j.lindif.2020.101849

Santomauro et al., 2020 C.M. Santomauro, A. Hill, T. McCurdie, H.L. McGlashan. **Improving the quality of evaluation data in simulation-based healthcare Improvement projects: A practitioner's guide to choosing and using published measurement tools** Simulation in Healthcare, 15 (5) (2020), pp. 341-355, 10.1097/SIH.0000000000000442

Saylor et al., 2016 J.L. Saylor, S.F. Wainwright, A.E. Herge, R.T. Pohlig. **Development of an instrument to assess the clinical effectiveness of the debriefer in simulation education** Journal of Allied Health, 45 (3) (2016), pp. 191-198

Schuster et al., 2020 C. Schuster, F. Stebner, D. Leutner, J. Wirth. **Transfer of metacognitive skills in self-regulated learning: An experimental training study** Metacognition and Learning, 15 (3) (2020), pp. 455-477, 10.1007/s11409-020-09237-5

Simons, 2013 D.J. Simons. **Unskilled and optimistic: Overconfident predictions despite calibrated knowledge of relative skill** Psychonomic Bulletin & Review, 20 (3) (2013), pp. 601-607, 10.3758/s13423-013-0379-2

Stojiljković et al., 2018 E. Stojiljković, A. Bozilov, T. Golubovic, S. Glisovic, M. Cvetkovic. **Human error prevention by training design: suppressing the dunning-kruger effect in its infancy** Occupational Safety and Hygiene VI, CRC Press, Boca Raton (2018), pp. 219-223

Sullivan et al., 2019 P.J. Sullivan, M. Ragogna, L. Dithurbide. **An investigation into the Dunning–Kruger effect in sport coaching** International Journal of Sport and Exercise Psychology, 17 (6) (2019), pp. 591-599, 10.1080/1612197X.2018.1444079

Vener et al., 2017 S.M. Vener, A.M. Wichnick-Gillis, C.L. Poulson. **Observational Methods** Handbook of social behavior and skills in children, Springer, Cambridge (2017), pp. 83-99

Wang et al., 2020 P.Z.T. Wang, W.Y. Xie, S. Nair, S. Dave, J. Shatzer, S. Chahine. **A comparison of guided video reflection versus self-regulated learning to teach knot tying to medical students: a pilot randomized controlled trial** Journal of Surgical Education, 77 (4) (2020), pp. 805-816, 10.1016/j.jsurg.2020.02.014

Welsher et al., 2018 A. Welsher, D. Rojas, Z. Khan, L. VanderBeek, B. Kapralos, L.E. Grierson. **The application of observational practice and educational networking in simulation-based and distributed medical education contexts** Simulation in Healthcare, 13 (1) (2018), pp. 3-10, 10.1097/SIH.0000000000000268

West and Eaton, 2019 K. West, A.A. Eaton. **Prejudiced and unaware of it: Evidence for the Dunning-Kruger model in the domains of racism and sexism** Personality and Individual Differences, 146 (2019), pp. 111-119, 10.1016/j.paid.2019.03.047

Wu and Dunning, 2018 K. Wu, D. Dunning. **Hypocognition: Making sense of the landscape beyond one's conceptual reach** Review of General Psychology, 22 (1) (2018), pp. 25-35, 10.1037/gpr0000126

Wu and Dunning, 2020 K. Wu, D. Dunning. **Hypocognition and the invisibility of social privilege** Emerald Publishing Limited (2020), pp. 1-23, 10.1108/s0882-614520200000037001