Concept	Findings
Context (learning and clinical context)	
Time	• Time constraints for learning [e.g. 24, 49] vs. encouraging learner to pause and reflect [e.g. 50] • Typically time is a static component in VPs, learners are either rewarded for spending a long time on the VP [e.g. CASUS [54]] or for a quick problem solving approach, in which case a timer may be present [e.g. OpenLabyrinth [http://vpsystems.virtualpatients.net]
Authenticity, cognitive load	• The design of VP influences the balance between authenticity & complexity [e.g. 51] • Cognitive load of VPs is related to errors [e.g. 51] • VPs offer a controlled/safe environment in which teachers can focus on the learner [e.g. 32] • How does the transfer from virtual to real world work? [e.g. 31] • VPs are often based on fictive patient stories [e.g. 52], but are often implemented to prepare for real patient encounters [e.g. 53]
Emotions	• Emotions of the **patient** are more common in VPs to train communication skills than in clinical reasoning VP formats [e.g. 54, 55] • Emotions of the **learner** during interaction with VP are explored [e.g. 51, 56]
Learner-centeredness	
Feedback	• Feedback is an important determinant for engagement [e.g. 57] and varies from immediate feedback to feedback at the end of a scenario. • Different/adaptable feedback mechanisms have been implemented [e.g. 51, 31], but typically it is quantitative (e.g. list of correct diagnoses) [VP systems [http://vpsystems.virtualpatients.net]]
Adaptability	• VPs are typically tailored to the needs and level of a specific learner group, not on an individual level [http://vpsystems.virtualpatients.net], but • Adaption of level of difficulty helps avoiding an expertise reversal effect [e.g. 7] and the • Optimal design may depend on learner level [e.g. 7], meaning offering multiple learning strategies in varying context [e.g. 32, 47] • Overall, there is a discrepancy between adaptability and standardization of instruction [e.g. https://members.aamc.org/eweb/upload/Effective%20Use%20of%20Educational.pdf]]
Motivation, Engagement	• Motivation through assessment [e.g. 58] • Importance of making a VP engaging [e.g. 59]
Teaching/Assessment	
Methods	• VPs are assessment methods [e.g. 11], but also include assessment components, which are typically quantitative methods, such as multiple choice questions or decision points. [VP systems [http://vpsystems.virtualpatients.net]] • Applying more qualitative methods, such think-aloud approaches [e.g. 60] or concept mapping have been studied [e.g. 61], but are not commonly used. • Many cases are required to assess clinical reasoning skills [e.g. 7] • Mimic real patient management vs reliability [e.g. 44]
Scoring	• Assess and score all steps involved in the clinical reasoning process, but a detailed scoring of a stepwise approach may oppose non-analytical reasoning approaches [e.g. 7] • Scoring can cause negative emotions, such as frustration, thus, transparency of scoring is important [e.g. 51, 62] • The scoring approach depends on the VP format [e.g. 63] • Scoring metrics vary, e.g. costs or time are included in some VPs [e.g. 47], but, specific clinical reasoning process scores are often not provided [VP systems [http://vpsystems.virtualpatients.net]]
Communication	• Clear communication is an indicator for organized clinical reasoning skills [e.g. 47], but VPs are often designed to train either communication or clinical reasoning skills [e.g. 64]
Patient-centeredness [e.g. 48]	
Patient Safety & Errors	• VPs provide a safe environment for learners and educators [e.g. https://members.aamc.org/eweb/upload/Effective%20Use%20of%20Educational.pdf] and errors can be made, by making a wrong choice or giving a wrong answer, however, typical errors/biases of clinical decision making, such a anchoring or premature closure typically cannot actively made by the learner [VP systems [http://vpsystems.virtualpatients.net]] • Learning from errors is important [e.g. 47], but implementation is limited.

Biases	• Biases are usually not explicitly covered in clinical reasoning VPs, but studies have been implemented [e.g. 54] exploring the role of biases while learning with VPs.
Management decisions	• Management decision are usually included in the VP scenario before the conclusion of the scenario [VP systems [http://vpsystems.virtualpatients.net]]
Overconfidence	• Level of confidence with a differential or final diagnosis is implemented in some VPs [e.g. DxR [http://vpsystems.virtualpatients.net]]
Psychological Theories	
Illness Scripts	• Patient's illness scripts are implicitly included in VPs, but typically not explicitly visible to the learner and • the learner typically has to enter (or is provided) a list of problems, differential diagnoses, tests to perform, and management decisions [VP systems [52]
Knowledge Encapsulation	• Often, VPs are long [e.g. 52], which hinders working through many VPs • Longitudinal integration of VPs, to link basic and clinical knowledge [e.g. 65]
Metacognition	• Role of metacognitive self-awareness of the VP [e.g. 66] • Metacognitive strategies, such as questions for self-reflection, self-assessment or self-explanation are implemented in VPs [VP systems [http://vpsystems.virtualpatients.net] • Self-pacing, non-threatening environment, feedback and flexibility important requirements for metacognition [e.g. 38]
Pattern recognition - analytical reasoning	• VPs typically aim to teach analytical reasoning in a step-wise approach [e.g. 49]