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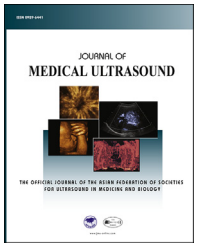

ORIGINAL ARTICLE

Continuing Development and Initial Validation of a Questionnaire to Measure Sonographer Skill-Teaching Perceptions in Clinical Practice

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Abstract *Objective:* Medical ultrasound examinations are performed by diverse professional cohorts: sonographers are one group. Little evidence exists regarding the teaching practices used in medical ultrasonography and their effectiveness. We report the continued development and validation of an instrument to measure sonographer skill-teaching practice perceptions (SonoSTePs).
Methods: An online survey was administered to a convenience sample of sonographers who were employed in Queensland, Australia. This paper reports on the continued psychometric testing of the measurement tool.
Findings: The 25-item scale demonstrated good internal reliability. Exploratory factor analysis generated four factors with acceptable internal reliability: Factor 1 (Skill execution feedback, Cronbach's $\alpha = 0.89$), Factor 2 (Cognitive overload, Cronbach's $\alpha = 0.68$), Factor 3 (Teach new skill, Cronbach's $\alpha = 0.70$), and Factor 4 (Assist learners scanning, Cronbach's $\alpha = 0.67$). The combined instrument value was 0.83. The weighted kappa of the test–retest items identified that the majority of items achieved an interrater level of agreement of $\geq$0.5.

Conflicts of interest: The Australian Sonographer Accreditation Registry was funded to disperse the P3 survey, through Flinders University research by higher degree grant funds.

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Conclusion: Results indicate that the SonoSTePs instrument items and factors are underpinned by theories and principles related to teaching a complex psychomotor skill. The initial data suggest that the tool is both reliable and valid.

Introduction

Medical ultrasound is now a ubiquitous imaging modality, and is used by a diverse professional cohort, for a wide range of clinical applications and contexts. It is a salient point, that for more than 40 years, medical ultrasound imaging has been largely performed by sonographers and doctors, in established disciplines such as radiology, cardiology, vascular surgery, and obstetrics and gynecology. In recent years, the clinical application of medical ultrasound in the health and education contexts has expanded. For example, rheumatologists, rather than solely relying on palpation of anatomy, use ultrasound imaging to guide targeted injections into tendons, bursa, and joints [1]. Similarly, midwives are using ultrasound imaging [2] to determine fetal number, presentation, and placental location. This ultrasound information assists the clinical management of patients. Furthermore, medical students attending universities in the United States use ultrasound to assist cognition of anatomy and pathophysiology during their undergraduate education [3,4]. Nevertheless, the single largest cohort to use ultrasound imaging in a diagnostic and clinical capacity remains sonographers. Despite this, there is no literature that we could identify which outlines the instructional approaches used by sonographers to teach the basic scanning skills required for competent clinical practice. Therefore, there is no knowledge of the teaching practices used by the educators in the profession, and consequently they cannot be objectively reviewed, examined, and assessed.

Anecdotally, the ultrasound profession uses a master apprentice or two-step skill-teaching model [5] to guide the acquisition of essential psychomotor skills. The model relies on the educator demonstrating and describing the task steps to the learner. To date, this instructional model has served the profession well. However, contemporary skill-teaching and motor-learning domain literature has identified that additional instructional steps are needed when teaching multipart and complex psychomotor skills [6], where a skill must first be acquired, then performed, and lastly learned.

One method to measure sonographer skill-teaching practice perceptions is to use a validated survey instrument. A review of the literature failed to identify a suitable measurement tool for this purpose. Thus, the sonographer skill-teaching practices survey, labeled SonoSTePs, was developed to identify and measure the major skill-teaching practices and perceptions used by sonographers, who perform formal or informal clinical teaching and supervision roles. To date, the content and face validity of the SonoSTePs instrument has been established [7]. However, as identified from the literature review, the analytics of the theoretical principles and instructional behaviors required to teach a complex and multipart psychomotor skill have not been determined. The five theoretical subscales related to the domain of teaching a psychomotor skill in the clinical health arena include: teach new skill, visual exemplar, cognitive overload, immediate error correction, and skill practice. The purposefully written items that explore the subscales related to teaching a psychomotor skill in the SonoSTePs instrument are yet to be validated, and therefore determine how accurately this newly developed scale will measure perceptions of skill-teaching practice.

The purpose of this paper is to report on the continued development and validation of the SonoSTePs instrument. In particular, this paper aims (1) to determine the instrument's reliability (test—retest and Cronbach's α coefficient) and (2) to report on the steps taken and outcomes of an exploratory factor analysis.

Method

Continued development of the SonoSTePs instrument

In 2012, we commenced development of the SonoSTePs instrument using published principles of survey design and construction [8,9] to measure the perceptions of sonographer skill-teaching practices. The discriminant ability of the instrument was improved by using a 7-point Likert-type rating scale [7].

The revised and reworded SonoSTePs P3 instrument has two primary components. The first consists of 23 questions seeking demographic information, clinical practice roles and qualification, skill-teaching behaviors, use of simulation to teach scanning skills, and four validation feedback questions. The second component contains 28 items exploring five theoretical domains related to teaching a psychomotor skill contained within a Likert-type rating scale.

Recruitment and sampling

The population targeted to receive the P3 survey included Queensland sonographers registered with the national and compulsory regulatory agency, the Australian Sonographer Accreditation Registry (ASAR). Schleyer and Forrest [10] explain that it is important when targeting an online population that the validation cohort is representative of the broader professional population and possesses the skills to undertake the instrument validation. The targeted cohort was purposefully and strategically chosen to pilot test the instrument as this professional group: (1) was composed of sonographers who worked in a range of geographically disparate locations (which included metropolitan, semirural, rural, and geographically remote areas); (2) performed a

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