International Journal of Speech-Language Pathology

ISSN: (Print) (Online) Journal homepage: www.tandfonline.com/journals/iasl20

Developing novice analysts' videofluoroscopic swallowing study skills in speech-language pathology: A randomised control trial comparing blended and online training approaches

Ann Edwards, Alison Holm, Paul Carding, Michael Steele, Elspeth Froude, Clare Burns & Elizabeth Cardell

To cite this article: Ann Edwards, Alison Holm, Paul Carding, Michael Steele, Elspeth Froude, Clare Burns & Elizabeth Cardell (2024) Developing novice analysts' videofluoroscopic swallowing study skills in speech-language pathology: A randomised control trial comparing blended and online training approaches, International Journal of Speech-Language Pathology, 26:2, 212-224, DOI: 10.1080/17549507.2023.2212142

To link to this article: https://doi.org/10.1080/17549507.2023.2212142

International Journal of Speech-Language Pathology, 2024; 26: 212–224

Taylor & Francis
Taylor & Francis Group

Developing novice analysts' videofluoroscopic swallowing study skills in speech-language pathology: A randomised control trial comparing blended and online training approaches

ANN EDWARDS[1,2], ALISON HOLM[1,3], PAUL CARDING[2,4], MICHAEL STEELE[2], ELSPETH FROUDE[5], CLARE BURNS[6] & ELIZABETH CARDELL[7]

[1]*School of School of Health Sciences and Social Work, Griffith University, Nathan, Australia,* [2]*School of Allied Health, Australian Catholic University, Brisbane, Australia,* [3]*School of Health Sciences, University of Tasmania, Launceston, Australia,* [4]*OxINMAHR, Oxford Brookes University, UK,* [5]*School of Allied Health, Australian Catholic University, North Sydney, Australia,* [6]*Royal Brisbane and Women's Hospital, Queensland Health, Brisbane, Australia,* [7]*School of Medicine and Dentistry, Griffith University, Southport, Australia*

Abstract

Purpose: This research investigates the relative effectiveness of independent online and blended learning approaches for novice analysts' development of videofluoroscopic swallowing study (VFSS) analytical skills. The secondary aims were to explore the impact of training on decision-making and to describe learners' perspectives of training outcomes.

Method: Undergraduate speech-language pathology students ($n = 74$) who had completed the dysphagia academic curriculum in an undergraduate speech-language pathology program were recruited for a randomised control trial. The ability to identify swallowing impairments in adults was compared pre- and post-training across three conditions: independent online ($n = 23$), peer-supported ($n = 23$), and expert-facilitated training ($n = 28$). The training comprised online VFSS training and practice with a commercially available digital video disc (DVD).

Result: The three training approaches were equal in improving novice analysts' identification of impairments on VFSS. Participants' analysis improved pre- to post-training ($p = <.001$), with no statistical difference amongst training conditions ($p = .280$). However, the expert facilitation condition resulted in better decision-making skill for novice analysts, as well as higher levels of confidence and greater engagement in the learning.

Conclusion: Well-designed independent online methods are appropriate to prepare novice analysts for VFSS analytical training. Expert facilitation and peer-supported environments may have benefits for more advanced skill development and engagement, and should be investigated in future studies.

Keywords: *VFSS; training; blended; online; dysphagia; swallow*

Introduction

Videofluoroscopic swallowing study (VFSS) analysis relies on the speech-language pathologist's (SLP) perceptual skill and their knowledge of normal and impaired swallow. VFSS analysis requires SLPs to be systematically trained and credentialled to ensure quality of care. SLPs apply perceptual skill and clinical reasoning in the radiography suite to determine the presence of a swallowing impairment, the compensatory strategies to trial, and the point at which sufficient information has been collected. Following the completion of the study, SLPs conduct a frame-by-frame analysis and systematically describe the swallowing events. In some facilities, quantitative measures are used to provide an objective description of the person's swallow (Nordin et al., 2017). However, the perceptual analysis continues to be critical in the assessment of swallowing, and satisfactory interrater reliability relies on the use of a high-quality standardised framework and training (Edwards et al., 2021). Despite the complexity and importance of the task, there has not yet been a systematic evaluation of VFSS training methods.

Correspondence: Alison Holm, School of Health Sciences, University of Tasmania, Launceston, Australia. E-mail: alison.holm@utas.edu.au

ISSN 1754-9507 print/ISSN 1754-9515 online 2023 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group
Published by Taylor & Francis
DOI: 10.1080/17549507.2023.2212142

The analysis process, which occurs in real-time in the radiography suite and through frame-by-frame analysis after the study, has evolved over time (Edwards et al., 2021). The prescription of effective swallowing rehabilitation requires an accurate description of swallowing that considers different impairments such as weakness, spasticity, apraxia, respiratory disturbance, or sensory change (Clayton et al., 2014; Huckabee & Lamvik-Gozdzikowska, 2018). SLPs apply their knowledge of sensory deficits, respiratory conditions, ageing, and interruption to the central control on swallowing (Clayton et al., 2014; Daniels et al., 2019; Huckabee & Lamvik-Gozdzikowska, 2018). This allows them to select appropriate compensatory strategies to trial during the VFSS and informs their post-study decisions about management and rehabilitation (Edwards et al., 2019). Expectations of VFSS clinicians' knowledge and skill have risen in the speech-language pathology profession as the evidence base has grown in the past 20 years. Therefore, VFSS training has required an increased investment of time and resources from SLPs and health services (Edwards et al., 2019; Stoeckli et al., 2003).

To standardise perceptual evaluation, defined rating tools and frameworks have been created and validated to address issues of poor interrater reliability (Edwards et al., 2021; Silbergleit et al., 2018). A recent systematic review of the literature found direct training with an expert facilitator, often conducted in groups, was the most common approach reported (Edwards et al., 2021). There was also evidence for effective self-directed, independent online training (Taubert et al., 2021). There was limited evidence found in the review for the heterogeneous training methods described for VFSS rating tools and frameworks (Edwards et al., 2021).

Expert-facilitated, peer-supported, and independent online modes of training may provide appropriate VFSS training, with each mode having advantages and disadvantages.

Expert-facilitated learning

A one-on-one mentoring mode is a common approach for VFSS training in speech-language pathology, and expert-facilitated workshops and courses are available (Duivestein & Gerlach, 2011; Edwards et al., 2019). Expert facilitation allows learners to discuss their experience and receive immediate feedback and encouragement during training, tailored to the learner and environment (Duivestein & Gerlach, 2011; Kemp & Grieve, 2014). However, access to face-to-face training has been a barrier to the development of SLPs' VFSS competency due to limited availability and workplace flexibility, and the logistics of the location of training and trainers (Burns et al., 2021; Duivestein & Gerlach, 2011; Edwards et al., 2019; Taubert et al., 2021). Alternative methods may provide better access, but present different advantages and limitations for training.

Peer-supported learning

In the literature describing the positive impacts of VFSS analytical training, expert-facilitated training in small groups was a common theme (Edwards et al., 2021). This finding raises questions about the influence of peers and discussion on learning in the presence of facilitation. Peer-supported learning fosters collaborative, active learning and is known to improve motivation, discussion, and learning outcomes (Loes, 2022). Further, peer-supported training in groups might reduce the cost of expert-facilitated training. However, it has been suggested that trainees can lack confidence in the absence of a content expert (Moore, 2017).

Organising training groups in the workplace can be a logistical challenge for both peer-supported or expert-facilitated training. This challenge can be exacerbated for small and geographically dispersed health services and for curricula that extend beyond the limits of an intensive workshop, or if distributed sessions are required.

Independent online learning

Asynchronous independent online learning allows training materials to be developed once; therefore, multiple learners can work independently, in their own location and available time, and at their own pace (Fabriz et al., 2021). The advantages of independent online learning have been demonstrated for SLPs at the beginning of their VFSS analytical training.

Burns et al. (2021) reported a study where SLPs completed an online training program. The program included theoretical content about the purpose of VFSS, anatomy and swallowing physiology, and radiation safety. It also focused on clinical skills and practice analysing VFSS images, prescribing rehabilitation and compensation, and report writing. At the end of the training, participants reported increased knowledge, skills, and confidence in VFSS analysis (Burns et al., 2021).

Another independent training approach is the Modified Barium Swallow Impairment Profile approach (MBSImPTM). This training provides a standardised approach to VFSS protocol, analysis, and competency assessment. It was introduced as a blended package (i.e. online activities plus face-to-face didactic teaching) but is now offered wholly online as a self-directed learning package (Martin-Harris et al., 2008; Northern Speech Services, 2021).

While independent online training methods for VFSS have the potential to address some of the barriers presented by face-to-face methods, they have not yet been compared with traditional expert-facilitated or peer-supported modes (Burns et al., 2021;

Martin-Harris et al., 2008). The disadvantages of an independent online environment include the inability to receive real-time feedback with verbal and non-verbal cues, and a sense of learning not being personalised (Fabriz et al., 2021). Independent online study also does not provide the opportunity for discussion as afforded by expert-facilitated and peer-supported settings, which benefits learning (Moore, 2017; Edwards et al., 2019; Versteeg et al., 2019).

Blended learning

Blended learning involves the deliberate combination of independent online methods with face-to-face, peer-supported, and expert facilitation to best utilise resources and maximise the advantages of each approach (Boelens et al., 2017; Kintu et al., 2017). Education researchers have explored the benefits of blended learning and this method may also benefit SLPs as they begin to learn VFSS analysis. Online methods may be particularly appropriate for the development of skills that do not require a physical presence in the clinic. For example, the analytical skills of detecting and describing impairments in VFSS images, the use of standardised tools for this analysis and reporting, and the application of foundational knowledge of swallowing theory with case information to inform intervention strategies can all be done outside the clinic. The addition of face-to-face elements—facilitation or peer support—may further enhance the effectiveness and acceptability of independent online training.

Despite this evidence for the use of different training approaches, there are no comparative studies. Learner outcomes from VFSS training using independent online learning modes have not been compared with the outcomes of blended modes that include either expert facilitation or peer support. It is not known if independent online training is equally effective as alternative approaches requiring expert facilitation or peer support to develop initial VFSS analytical skills. If independent online training is comparable, this would mean that people who need the flexibility and accessibility of independent training, particularly small services and rural and remote SLPs (Taubert et al., 2021), can be confident that they are accessing effective training. If expert facilitation or peer support is more effective than online learning, this would mean that educators could accentuate these elements in their training approaches to maximise learning outcomes.

Aims

The aim of this paper was to determine the effect that different training modes have on developing VFSS analytical skills in novice analysts. This research compares three training modes: (a) independent online; (b) online plus expert facilitation (blended); and (c) online plus peer support (blended).

The primary outcome measure was to compare the impact of the three training modes on novice analysts' ability to detect signs of adult swallowing dysfunction. The secondary outcome measures were to compare the impact of training mode on novice analysts': (a) knowledge of swallowing; (b) decision-making about compensatory strategies to trial; and (c) perception of improvement and learning mode preference. It was hypothesised that independent online learning would be as effective for novice analysts as blended approaches that add expert facilitation and peer support to the same online training.

Method

This randomised control trial study was approved by The Australian Catholic University Human Research Ethics Committee (2017-244ERC).

Participants

Participants were students completing a Bachelor of Speech Pathology program with a national curriculum at an Australian university that has campuses in three states. The curriculum and materials in this degree program were identical across the campuses. Students in their third or fourth year of the four-year program who had successfully completed the academic curriculum for dysphagia were eligible to participate, and 430 students were invited by email to volunteer to participate. The only exclusion criterion was uncorrected visual deficits, as self-reported by the student. As this study was concerned with responses to different training modes, a population of undergraduate students rather than qualified practising SLPs was selected to reduce the influence of clinical experience and professional development on the results (Chan & Cheng, 2017; Gosa et al., 2015).

Participants gave informed written consent prior to entering the study and 97 students were randomised into one of three conditions: independent online training, peer-supported training, or expert-facilitated training. There was a high rate of attrition prior to randomisation and commencing the training: 23 fourth-year participants withdrew from the study (reasons for withdrawal: 17 successfully gained full-time employment as SLPs; one was unable to secure childcare for training; and five gave no reason for withdrawal). The remaining 74 participants completed the training. The 74 participants were randomly allocated to a single training condition by an administration officer using the random number generator in Statistical Package for Social Science (SPSS) version 27 (IBM Corp, 2020). Of the 74 participants, 23 completed independent online training, 23 completed training in a peer-supported group, and 28 completed training in an expert-facilitated group. The mean age of participants in this study was 23.85 years ($SD = 6.74$; range = 20–57) with no significant difference in age across the training condition

groups. Of the 74 participants, four were men, three of whom were in the peer-supported condition and one in the expert-facilitated condition.

Pre- and post-training assessment measures

Participants completed a 120 min pre-assessment session and a 90 min post-assessment session. The assessment sessions were conducted in a computer laboratory at the student's university campus. Assessment sessions were conducted immediately before and after the first and last training session, respectively. Additional data were collected at the pre-assessment for a related study that is reported separately. Figure 1 illustrates the flow of participation.

Knowledge of swallowing physiology

The participants completed an 11 question online multiple-choice questionnaire assessing their knowledge of swallowing physiology before and after training (the questions are included in the online supplementary material). Questions were created by the first author and assessed content that the participants had learned in their undergraduate degree studies. The questionnaire was designed with 13 questions and was piloted by three practising SLPs to ensure the questions were valid. The data for two questions were removed from the dataset after feedback from the SLPs about the ambiguity of the wording.

Knowledge of anatomy

Participants were asked to identify eight structures on still VFSS images (in the lateral view). The structures were anatomical landmarks or were involved in assessable events in VFSS analysis. These included the hard palate, the angle of the mandible, the anterior tongue, the posterior pharyngeal wall, the base of the tongue, the cricopharyngeus, the epiglottis, and the valleculae. The images were projected onto a large classroom screen in a darkened room, with the image progressing once all participants in the assessment group had indicated that they were ready for the next one.

VFSS analysis

Participants rated three VFSS boluses from three unique adult patients, pre- and post-training. All VFSSs were captured at 30 frames per second and projected as previously. An additional case was included in the post-training assessment to assess the relative performance of each group without a possible test-retest effect. The participants did not receive case histories. Case details are provided in Table I.

The ratings were completed using the Modified Barium Swallow (MBS) Checklist from the VFSS eLearning Package (adapted from Burns et al., 2021; Huckabee & Lamvik-Gozdzikowska, 2018), the Penetration and Aspiration Scale (PAS; Rosenbek et al., 1996), and a bolus clearance scale (adapted from Daniels et al., 2006). The VFSS analysis assessment was piloted with three novice analysts prior to recruitment for this study. The number of presentations was determined according to the novice

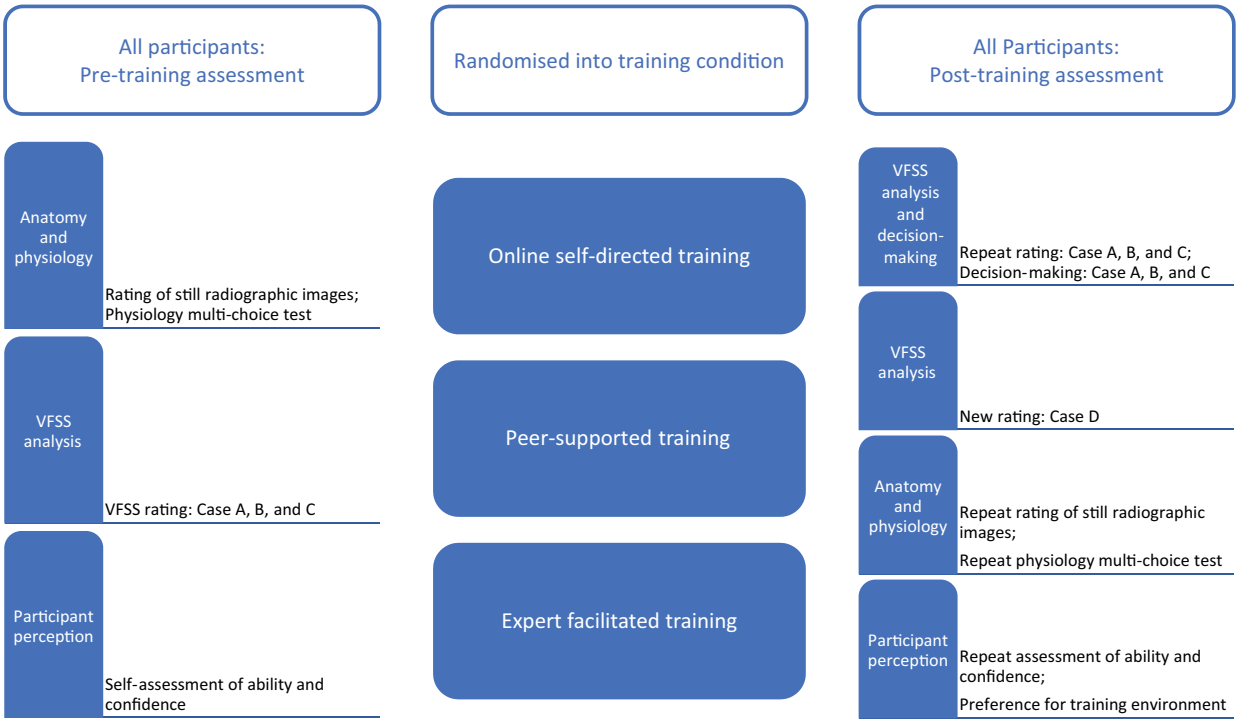

Figure 1. Participation flow.

Table I. Pre- and post-training assessment case details.

Case	Case description	Penetration-aspiration scale rating	Use in pre- or post-training assessment
A	Patient with sensory deficits; self-administered thin fluid from a cup; initiated the swallow as the bolus spilled to the pyriform region; reduced base of tongue to posterior pharyngeal wall contact; impaired pharyngeal squeeze; reduced anterior and superior laryngeal movement; residue in the valleculae and pyriform fossae; silent aspiration.	8	Pre + post
B	Patient self-administered thin fluid from a cup; incomplete laryngeal anterior and superior laryngeal movement; incomplete epiglottic closure; reduced opening of upper oesophageal sphincter; fluid entering beneath the epiglottis during swallow; prompt and complete vocal fold closure; all material cleared from the airway; mild residue remaining in pyriform fossae.	2	Pre + post
C	Patient eating bread; reduced bolus preparation; impaired transfer of soft solid bolus; reduced tongue base to posterior pharyngeal wall contact; moderate residue in the valleculae after the swallow; no material entering the airway.	1	Pre + post
D	Patient self-administered thin fluid from a cup; impaired bolus control; buccal/sublingual pocketing; reduced tongue to palate contact; reduced base of tongue to posterior pharyngeal wall contact; premature spillage to the pharynx with fluid filling the valleculae and spilling to the pyriform fossae before initiation of swallow.	Bolus 1: 5 Bolus 2: 8	Only post

analysts' assessment in the pilot of when they felt they had sufficient opportunity to find the "main problem" as best as they were able with three speeds.

The VFSS images were consequently presented three times at normal speed (with the sound turned on), six times at 0.5 speed, and once at 0.3 times speed (with the sound turned off) in the pre- and post-assessment. The limit on the number of views was intended to avoid a ceiling effect and to approximate the pressure of the radiography suite. In the post-training assessment, the participants rated the additional two VFSSs for Case D under the same protocol.

Novice analysts' perception of improvement and preference for training mode

Participants completed an online survey following their training in one of the three conditions. The survey included a 100-point slider scale question, anchored from "strongly agree" to "strongly disagree", to gauge agreement with the statement: "My training was successful in helping me learn to analyse VFSS." Participants also answered the following free-text question: "We tested online training, peer support training, and training in small groups with an expert facilitator. Which method do you think you would have preferred? Why?"

Training protocol

Data collection took place in three blocks of three weeks, one week per campus, over two years. Independent online, peer-supported, and expert-facilitated training was conducted simultaneously at each campus during these blocks. The participants from all conditions completed the pre- and post-assessment together, immediately before and after training. Details about the experience of participants in each training condition are provided in Table II.

The first part of each training day addressed one or two modules of the VFSS eLearning Package, an interactive multimedia program, which is comprehensively described by Burns et al. (2021). The second part of each training day targeted rating practice or answering questions about VFSS images from a commercially available digital video disc (DVD; Newman & Nightingale, 2012). The list of topics covered in training were as follows: (a) Introduction, Background, and the Normal Swallow; (b) Anatomy and Physiology; (c) Swallow Strategies, Rehabilitation, and the VFSS Procedure; (d) Interpretation, Measurement, and Rating Scales; and (e) Report Writing. The DVD cases reviewed were the following: Typical Young and Aged Swallowing, Stroke, Neurological Diseases, Structural Dysphagia, and Developmental Disability.

Outcome measures

The participants' accuracy in identifying swallowing impairments was the primary outcome of interest. The participants' ability to identify the parameters of the swallow that were within normal limits is also reported.

Secondary outcome measures included the impact of training on the participants' ability to prescribe compensatory and rehabilitation interventions, and on the participants' knowledge of anatomy and physiology related to swallowing. The students' perspectives of their learning outcomes and their engagement in training were also explored.

Standard

Accuracy for all ratings was determined against a standard that was set by three SLPs who were practising VFSS analysts with 22 years (mean) experience in dysphagia management. All raters had completed the VFSS eLearning program as part of their facility's new VFSS competency program. Two of the raters

Table II. Details of independent online, peer-supported, and expert-facilitated training.

Training condition	Description of each group's participant experience
Independent online	• Provided with a VFSS eLearning Package (a USB and DVD of VFSS cases); • provided with a guide to topics and cases, prompts for reflection, and rating forms and answers so participants could self-assess accuracy (guide developed by first author, a qualified SLP with extensive experience teaching dysphagia at university and clinical dysphagia management); • instructed not to collaborate or seek external support during training; • worked through the material at own pace over a 5 day period.
Peer-supported	• Training completed at university in groups of two to five students without a facilitator; • received the same VFSS eLearning Package as the independent online group; • written guide included an additional brief introduction to learning in groups and prompts to guide peer group discussion while working through the online modules and ratings; • total of 15 hr of VFSS analysis training over five consecutive days (an average of three hours per day).
Expert-facilitated	• Training completed at university in groups of three to six with an expert facilitator in the room (the first author); • worked through the same VFSS eLearning Package as the other groups; • written guide did not include answers to the DVD cases; • could ask questions as they completed the online material and receive immediate feedback from the facilitator; • SLP facilitated the practice of rating the VFSS studies from the DVD with the sound turned off, before viewing it with narration; • total of 15 hr of VFSS analysis training over five consecutive days (an average of three hours per day).

were currently responsible for conducting, analysing, and reporting on VFSS in their facility. The SLP raters met together and viewed the training VFSS cases in an AVI format, with the opportunity to pause and replay the studies and with control over the speed of the replay. Through discussion, the three SLPs reached a consensus for all aspects of the ratings for all cases.

Rating

The novice analysts completed the MBS Checklist rating tool from the VFSS eLearning Package (see supplementary materials). The MBS Checklist is organised into parameters of swallowing. For each parameter, there is a list of possible impairments (see the online supplementary material for details). Raters indicate that a parameter is within normal limits (as described in the tool) or indicate one of the possible impairments. The tool requires binary yes/no decisions.

The participants' relative performance on identifying parameters of the swallow that were within normal limits was also compared to confirm the findings relating to the impact of training on accuracy. The participant was scored as correct if they:

a indicated that a parameter (for example, lip closure) was within normal limits in agreement with the standard; or
b left the checkbox about normal function unmarked as per the standard when an impairment was present, and an impairment was indicated beneath.

If the participant did not indicate the function was within normal limits when an impairment was present but did not select an impairment, then the item was scored as incomplete.

The participants also made non-binary decisions regarding the position of the bolus at the time of swallow initiation, the depth to which material enters the airway, and the consequent response (the 8-point PAS; Rosenbek et al., 1996). They completed a 4-point residue rating scale (adapted from Daniels et al., 2006) for the oral cavity, valleculae, and pyriform fossae. The participants did not rate the timing of the swallow, as they were not able to do a frame-by-frame analysis. The participants' performance on all checklist ratings for the previously unseen VFSS (two swallows from one patient) is presented to provide comparison across the three conditions, without the influence of a test-retest effect.

Secondary outcomes

Influence of training on knowledge of anatomy and physiology

The participants' performance on identifying anatomical landmarks on a still image was measured. The participants' pre- and post-training results across the three conditions for the knowledge of swallowing physiology test were similarly assessed.

Decision-making

The participants were asked to indicate what compensatory strategies they might trial next, immediately after rating case A, B, and C during the post-training assessment. Participants were instructed to assume there was no contraindication to any strategy. Participants had learned about compensatory strategies in the training but did not have access to their training materials when making this decision. All participants provided multiple strategies for at least one of the three cases. Compensatory strategies were coded as "indicated" (i.e. correct) if they matched the strategies taught in the training material for a particular swallowing concern. When other strategies were given, they were coded as "not indicated" (i.e. incorrect). Trials of thickened fluid or modified solids were scored as "not indicated", as the training clearly instructed students to try other compensatory methods before adjusting the consistency of the bolus. The codes were summed across the cases for each

participant, creating a score out of three for cases in which one indicated strategy was provided. The same procedure was followed for cases in which a strategy that was not indicated was provided.

Novice analysts' perceptions of learning

Participants' perceptions about the attainment of their learning outcomes and their engagement with the training materials were collected via an online questionnaire administered immediately post-training. The participants rated the following statements on a 100-point sliding scale anchored from "strongly agree" to "strongly disagree": "I have enough understanding of anatomy and physiology for VFSS analysis"; "It is easy to see the anatomy in VFSS and to track the bolus"; "I am confident in my ability to analyse VFSS"; "I am confident in my ability to learn to analyse VFSS"; and "I am interested in the analysis of VFSS". The students also rated their engagement with the learning activities on a 5-point scale, anchored from "very engaged" (1) to "very Ddisengaged" (5), by answering the following question: "How engaged were you with the course material and activities? You can be honest!"

Sample size and data analysis

Statistical analysis

Using an alpha of 0.05 and a power of 0.8 based on comparing the average of the three groups, a sample size of 20 participants per group was required to detect a moderate effect. Repeated measures analysis of variance (ANOVA) and one-way ANOVA were used when the assumption of normality of the data's distribution could be assumed, and non-parametric alternatives were used when the assumptions for these tests were not satisfied. A p-value $\leq .05$ was deemed statistically significant and, where post hoc comparisons were made, a Bonferroni correction was applied. All analyses were conducted with IBM SPSS version 27 (IBM Corp, 2020).

The primary outcome—identification of impairments by participants according to training mode—was compared using repeated measures ANOVA to allow the interacting effect of time and training mode on the identification of impairments to be evaluated. As the identification of individual impairments within swallowing parameters was a binary decision, this was not combined with the non-binary rating of the PAS, residue, and the anatomical boundary of the bolus at the initiation of the swallow. As these latter variables were not normally distributed, a Wilcoxon signed ranks test was used to compare the entire cohort's performance on these measures before and after training. A new variable measuring the difference between the post- and pre-test results for each participant was compared across conditions using a Kruskal–Wallis test.

The distributions of the participants' identification of appropriate compensatory interventions as learned in training, and their identification of interventions that were not indicated for the three cases, were compared across groups using a Kruskal–Wallis test. Post-training ratings of the participants' perspectives of their training outcomes and engagement during training were compared across training groups using a Kruskal–Wallis test.

Missing data

There were missing data for the primary outcome measure and pre- and post-ratings. Two students did not complete the post-assessment: one was required to work and the other did not give a reason. One student was unable to complete the pre-assessment due to caring responsibilities. All were in the online group. One student from the peer-supported group did not submit the final online physiology assessment. As a result, these participants' data were not used in any analysis requiring the use of pre- and post- data.

Qualitative analysis

The participants' preferred training mode was recorded in response to the question, "Which method do you think you would have preferred? Why?" A research assistant, independent to this study and blinded to the training condition of the participants, conducted the qualitative analysis of the free text discussion about the perceived benefits of training. A codebook was created, with a code and definition generated for each new instance of meaningful data. These codes were applied to the free text generated by the question and audited by the first author.

Result

The pre-test age and training variables were shown with a Kruskal–Wallis test to not be significantly different between the three groups. The pre- and post-training results are reported for each aspect of the VFSS ratings. The relative performance across training conditions on the additional task (the case D analysis) was consistent with the performance before and after training, providing assurance that the relative performance of participants across conditions was not influenced by using the same VFSS cases in the pre- and post-assessment. For readability, the results of the participants' performance on the previously unseen VFSS presented in the post-training assessment (case D) are reported in Table S1 of the online supplementary material.

Primary outcomes: Identification of swallowing impairments

Participants improved in the identification of impairments in swallowing parameters according to the checklist in all training conditions (F [1, 68] = 23.379; p = <.001). The interaction between the

three training modes and time was not statistically significant (F [2, 68] = 1.299; $p = .280$).

The mean number of impairments that were correctly identified pre- and post-training for participants in each mode is provided in Table S2 of the online supplementary material. Of the 71 participants with pre- and post-assessment data, 57 identified a greater number of impairments after the training and 19 identified the same number of impairments or fewer.

Identification of aspects of the swallow that were within normal limits

After training, a significant improvement in identifying parameters of the swallow that were within normal limits was found (F [1, 68] = 53.602; $p = <$ .001). The interaction amongst the training conditions was not statistically significant (F [2, 68] = 1.205; $p = .306$). The descriptive statistics for the ratings of normal swallowing stages are available online as supplementary material.

PAS, position of bolus at swallow onset, and residue rating

The participants rated the PAS ($Z = -5.27$; $p = <.001$) and the place of the bolus at the onset of the swallow more accurately post-training ($Z = -4.29$; $p = < .001$). The rating of residue pre- to post-training did not improve ($Z = -1.54$; $p = .122$). There was a statistically significant difference between groups when rating the position of the bolus at the initiation of the swallow, with the peer group improving less than the expert-facilitated group (H [2] = 6.707; $p = .035$ and $p = .041$). There was no statistical difference between the peer-supported and independent online groups ($p = 1.000$), nor between the expert-facilitated and independent online groups ($p = .221$), on the pre- to post-training change for this rating. The difference between the expert-facilitated and peer-supported groups on ratings of the bolus position at the initiation of the swallow is explained by the peer-supported group's higher mean prior to the training. Prior to training, the mean number of correctly rated bolus positions at the initiation of the swallow (from three ratings) and standard deviation for each group were as follows: expert-facilitated = 0.57 (0.69); peer-supported = 1.13 (0.82); and independent online = 0.95 (0.95). Following the training, the three groups' performances were comparable when rating the position of the bolus at the initiation of the swallow: expert-facilitated = 1.54 (0.79); peer-supported = 1.39 (0.66); and independent online = 1.35 (0.93).

There was no statistical difference between the groups with regards to the improvements pre- to post-training on the PAS or residue ratings (H [2] = 3.551, $p = .169$ and H [2] = 3.660, $p = .160$, respectively).

Secondary outcomes

Effect of training on knowledge of swallowing

Anatomy. The participants improved in their ability to identify anatomical landmarks on still radiographic images (scored out of 8) after training (F [1, 70] = 89.399; $p = < .001$). There were no significant effects related to training condition on the accuracy of rating anatomical landmarks on still images (F [2, 70] = 0.846; $p = .433$). The group means and standard deviations for the test of anatomy prior to training were as follows: expert-facilitated = 3.93 (1.59); peer-supported = 4.00 (1.57); and independent online = 3.50 (1.63). After training, the group means and standard deviations for the test of anatomy were as follows: expert-facilitated = 5.54 (1.45); peer-supported = 5.48 (1.20); and independent online = 5.55 (1.37).

Physiology. The participants also improved in their performance on swallowing physiology (scored out of 11) post-training (F [1, 71] = 21.066; $p = < .001$]. No statistically significant difference was found between the groups' performance (F [2, 71], $p = .820$). For context, the errors on this assessment are also reported in Table S3 of the online supplementary materials. There were fewer incorrect answers post-training, particularly in the peer-supported group, which had a higher rate of incorrect answers pre-training.

Decision-making

A statistically significant effect of training mode was found after training on the ability to identify appropriate compensatory strategies to trial (H [2] = 8.959; $p = .011$). In the three cases, the expert-facilitated group identified an appropriate recommendation for compensatory trials [mean (SD) = 2.37 (0.742)] more often than did the peer-supported (mean [*SD*] − 1.78 [0.795]; $p = .022$) and independent online groups (mean [*SD*] = 1.87 [0.626]; $p = .046$). There was no significant difference between the peer-supported and independent online groups in terms of the number of indicated recommendations made ($p = 1.000$). There was no statistically significant difference across the training modes when the number of strategies offered that were "not indicated" were compared ($p = .054$). Descriptive statistics are reported in Table S4 of the online supplementary material.

Participant perception of improvement and preference for environment

After training, all but one of the participants indicated that they believed the training was successful in helping them to improve their VFSS analytical skill ($N = 72$, mean = 84.63, $SD = 17.22$). There was a statistically significant difference between the

perception of improvement amongst the groups (H [2] = 24.003; $p = < .001$), with the perception being statistically higher in the expert-facilitated group than in the peer-supported group ($p = .009$) and the independent online group ($p = < .001$). There was no statistically significant difference between the peer-supported and independent online groups' perception of improvement ($p = .309$). Descriptive statistics are reported in Table S5 of the online supplementary materials.

As a cohort, the participants reported a sufficient understanding of anatomy and physiology after training for VFSS analysis (mean [*SD*] = 73.56 [17.25]). They agreed that seeing the bolus and anatomy was easy (mean [*SD*] = 74.35 [18.05]), and they reported confidence in both the analysis (mean [*SD*] = 65.47 [21.72]) and in learning how to analyse (mean [*SD*] = 85.26 [18.13]). The cohort reported a high level of interest in VFSS analysis after training (mean [*SD*] = 90.68 [17.06]).

There was no statistical difference between the groups' confidence in their ability to learn (H [2] = 3.235; $p = .198$) or their interest in VFSS (H [2] = 1.846; $p = .397$). There was a significant effect of training mode on confidence in the knowledge of anatomy and physiology for VFSS after training (H [2] 14.80; $p = .001$). The expert-facilitated training participants reported greater confidence in their knowledge of anatomy and physiology than did participants in the peer-supported ($p = .010$) and independent online training ($p = .001$) groups.

There was also an effect of training mode on the perceived ability to see the bolus and anatomy on VFSS (H [2] = 8.448; $p = .015$) and on confidence in the ability to analyse VFSS (H [2] = 10.018; $p = .007$). The expert-facilitated training participants reported statistically significant higher levels of confidence in their ability to analyse ($p = .005$) and their ability to see the anatomy and bolus on VFSS ($p = .014$), than did those who completed the independent online training.

Perceived engagement in learning activities also differed across conditions (H [2] = 24.552; $p = < .001$). The participants in the expert-facilitated condition reported higher engagement than both the peer-supported ($p = .027$) and independent online participants ($p = < .001$).

The descriptive statistics for the participants' perspectives of the impact of the training on their learning are reported in Table S6, and data relating to the comparison of perspectives between conditions are presented in Table S7 of the online supplementary materials.

Preference for training

In each condition, the majority of participants indicated a preference for expert-facilitated training at the end of the study. Overall, 85% of participants indicated a preference for training with an experienced SLP (either as a stand-alone or blended approach). This observation was consistent across conditions: 77% of the expert-facilitated group, 77% of the peer group, and 70% of the online group reported a preference for expert-facilitated training. When a blended mode was included (expert-facilitated training plus online or peer support), the percentages increased to 84%, 82%, and 87%, respectively. Descriptive statistics for the preferences for online training and other alternatives are reported in Table S8 of the online supplementary material.

In the free text response, the participants discussed the value of being guided through their learning and being able to ask questions, to discuss concepts, to get feedback, and to hear about the facilitator's "real world" expertise. The participants in the expert-facilitated condition valued interaction with the facilitator in their training, and the participants in the other two conditions reported that they would value the opportunity to learn with a facilitator. The presence of peers was seen to offer a motivating, engaging, and supportive environment and gave the opportunity to discuss the materials. In the independent online group, the methods were valued for their flexibility, for reducing travel, and for the ability to learn uninterrupted and at a participant's own pace. The summary of codes and definitions from the free text data are presented in the online supplementary materials.

Discussion

This study investigated the influence of training mode on the development of analytical skill, decision-making, and participant perception for novice VFSS analysts. Specifically, we investigated the relative effectiveness of three training modes: independent online learning, peer-supported blended learning, and expert-facilitated blended learning.

Irrespective of the training mode, our novice analysts showed an improved ability to identify swallowing impairments, to determine the presence and depth of material entering the airway, to identify anatomical landmarks on still radiographic images, and increased knowledge of swallowing anatomy and physiology following training. Our hypothesis that independent online training would be as effective as peer-supported and expert-facilitated modes for the development of beginner analytical skill was supported. Therefore, this study provides data supporting the application of independent online training as a method to prepare learners for VFSS competency training.

However, some interesting differences across groups emerged in our secondary analyses. Participants in the expert-facilitated group more frequently identified compensatory strategies that were appropriate to the impairments present, according to the training materials, than did participants in the peer-supported or independent online groups. The

participants in the expert-facilitated group also made fewer suggestions that were not consistent with their training, although the difference did not reach statistical significance. The purpose of VFSS is not only to describe swallowing biomechanics, but to determine which rehabilitative and compensatory strategies to prescribe. Compared with the analysis and identification of impairments, decision-making about trials of compensatory strategies requires the higher-level skill of synthesis. It may be that facilitator feedback and discussion are of benefit in the development and consolidation of decision-making skills for VFSS (Nkhoma et al., 2017). Facilitation may assist in the development of this decision-making skill for novice analysts.

Participants in the expert-facilitated condition also had higher levels of confidence in their ability after training, and the participants in both the expert-facilitated and peer-supported training reported greater engagement in the learning activities than did their independently learning peers. In the higher education setting, students who interact with peers during learning have reported that peer feedback and support can increase feelings of competency and belonging (Fabriz et al., 2021). Awan (2021) suggests that peer learning in the radiography setting may become standard practice and that helping peers has the potential to develop a deeper understanding and retention of information, in addition to reducing the load on the expert trainers.

In countries where VFSS competency is acquired post-qualification (e.g. Australia; see Speech Pathology Australia, 2012), our findings support the hypothesis put forward by Taubert et al. (2021) and Burns et al. (2021) that independent online platforms are a valid method of providing initial VFSS training for novice analysts at a distance from major hospitals and training workshops. Given the time constraints described by SLPs (Edwards et al., 2019), independent online beginner VFSS analytical training has the potential to reduce the time required in the intensive mentoring phase of training. As the complexity of decision-making increases, feedback and facilitation may become more important for learning. Our results provide initial guidance to trainers as they design training. Consideration should be given to the use of online methods and the addition of face-to-face support along the trajectory towards competency. The relative benefits of independent online training blended with peer-supported and expert-facilitated delivery for specific skill development for SLPs advancing through VFSS competency is a worthy topic for future research.

The current study provides evidence that novice VFSS analysts benefit from training, including through independent, self-directed online learning. Our investigation with a student cohort also increases the applicability of the findings to undergraduate settings in countries that train VFSS as an entry-level skill for newly qualified SLPs. For countries that train VFSS analysis after graduation, such as Australia and the UK (see guidelines by Speech Pathology Australia [2012] and the Royal College of Speech and Language Therapists [2014]), these results suggest that standardised online methods, such as the one used in this study, extend the skills taught at the undergraduate level and can be incorporated into student training. Independent online training, therefore, could enable students to develop initial VFSS analytical skills prior to graduation to better prepare graduates for dysphagia management and the development of VFSS skills in the workplace. If adopted by national associations, such training could be standardised across higher education providers and health services, providing consistency of terminology, foundation knowledge, and approach across services.

As expert-facilitated discussion appeared to assist our participants in their development of decision-making skills, future research could explore whether the addition of an online peer support tool with facilitation (such as a discussion board or telementoring) might enhance participants' experience of learning through motivation and collegiate support, the opportunity to discuss concepts, and the ability to have questions answered.

It is interesting to note the low attrition rate once training had started. This was a voluntary activity, not core to the curricula, and all participants who began the training completed it, regardless of training condition. This suggested that our undergraduate students valued the opportunity to undertake this training, further supporting an argument to offer independent online VFSS training for undergraduate students, perhaps as an elective activity. Our high retention of trainees is in stark contrast to the findings by Riojas (2007), where only half of their participants completed an online training program of 10 web cases. The training in the present study was beginner level and not intended to produce competent SLPs (Burns et al., 2021). Anecdotally, many of our participants recognised the benefit of the training as they moved towards developing entry-level competencies and hoped participation might assist with their imminent job applications. Our training was time limited and participants were not required to reach a predetermined level of skill or knowledge to complete the program; it was not possible to fail. The retention of participants in longer online courses, with a competency requirement for completion, is an area for future research.

Our data on training preferences yielded some important training insights. There remained a strong preference amongst participants for expert-facilitated training, despite the objective and consistent improvements across all conditions. When asked why they preferred expert-facilitated training, the participants cited the ability to be guided in their learning, to ask questions and check their understanding of the

materials, and to discuss concepts related to real world clinical experiences in greater depth. The group environment was valued for its motivating quality and for avoiding the procrastination that can come with independent study.

For some participants, the independent online study was valued as it allowed them to comfortably move through the material at their own pace, reviewing the material as needed. These reasons are consistent with findings of studies of independent online training in other fields (Fabriz et al., 2021; Morgan et al., 2021).

Each mode had advantages for learning the skills of VFSS analysis, and trainers may benefit from systematically choosing when to apply each mode to prepare their learners according to the skills being developed and the limits of the training environment. Learners may also feel more confident and motivated if provided with evidence that beginning analytical skills are equally well developed online, and that independent online training has been successful in workplaces to prepare SLPs for expert-facilitated training (Burns et al., 2021; Taubert et al., 2021).

Given the pressure associated with conducting VFSS and the necessity to make decisions about compensatory strategies to trial online in the videofluoroscopy suite, the findings that decision-making and confidence are enhanced by facilitation are important for those who train VFSS. Independent online learning methods provide a valid and accessible method for teaching the skill of recognising swallowing impairments at a beginner level. As SLPs advance through their training, it is of interest to determine when peer support and facilitation enhance or expedite the achievement of learning outcomes. Our results suggest that for novice analysts, confidence is enhanced by peer discussion, support, and expert facilitation. The development of clinical decision-making likewise seemed to improve with access to an experienced facilitator. Future research should explore these variables along the trajectory of skill development from intermediate-level skill to final competency in VFSS training.

Limitations and future directions

We did not measure the time invested by the participants in the online condition in this study. The cost of time is an important factor to consider in future research due to reports in the literature that a major barrier to training in VFSS analysis is a lack of time (Burns et al., 2021). This study aimed to develop beginning analytical skills, restricted to the identification of impaired swallowing parameters, using a checklist. The participants in this study were at the start of their development of VFSS analyst skills and were a long way from being independent competent analysts. The development of more advanced diagnostic and management skills in online, peer-supported, and expert-facilitated learning environments remains to be determined, as our results suggest that these more advanced skills may benefit from an enhanced environment. As the participants were students, it is also possible that experienced SLPs may get different value from facilitation and peer interaction.

This study assessed relative accuracy in identifying impairments at the end of training, rather than the clinical acceptability of the endpoint. The assessment was also deliberately time limited and therefore measures the individuals' relative ability and speed, but not the actual competence of the participants when able to control the video playback.

The VFSS eLearning material included VFSS cases recorded at an acceptable 30 frames per second, but the quality of the commercially available cases on the DVD was mediocre. While the participants were able to replay training videos at full and reduced speed, they were not able to do a frame-by-frame analysis of any of the material in training—a feature that is necessary in the clinical environment and helpful in analysis. In future iterations of training, cases provided by hospitals will be provided for this additional practice, with the viewing software that accompanies commercial radiographic data storage, to enable frame-by-frame analysis.

Conclusion

This study demonstrated the equal effectiveness of three different training conditions in improving novice analysts' identification of impairments on VFSS. Having access to an expert facilitator showed some advantage for the development of certain clinical decision-making skills, and both the peer-supported and expert-facilitated conditions fostered greater engagement with the learning activities than did the online condition. The cumulative results suggest that SLPs and trainers can confidently use well-designed independent online methods to prepare SLPs for VFSS analytical training. Training with peers was perceived to increase engagement with learning material, and facilitation in small groups improved novice analysts' confidence in training and ability to identify compensatory strategies. This suggests that as the complexity of decision-making increases, facilitation may expedite or enhance the development of those higher-order skills.

Future research should compare online methods with blended peer-supported and expert-facilitated approaches to determine the best environment for the development of advanced rating and clinical decision-making in VFSS.

Ethics statement

This randomised control trial study was approved by The Australian Catholic University Human Research Ethics Committee (2017-244ERC).

Disclosure statement

The authors report no declarations of interest.

Supplemental material

Supplemental data for this article can be accessed online at https://doi.org/10.1080/17549507.2023.2212142.

Funding

This research was supported by the Australian Government Research Training Program and a Griffith University Postgraduate Research Scholarship.

ORCID

Ann Edwards http://orcid.org/0000-0003-0476-2195
Alison Holm http://orcid.org/0000-0002-9323-8055
Paul Carding http://orcid.org/0000-0002-4206-1827
Michael Steele http://orcid.org/0000-0001-9628-3057
Elspeth Froude http://orcid.org/0000-0002-6863-2317
Clare Burns http://orcid.org/0000-0002-9752-1739
Elizabeth Cardell http://orcid.org/0000-0002-8327-1003

References

Awan, O. A. (2021). Peer to peer learning: Its importance and benefits. *Academic Radiology*, *28*(5), 747–748. https://doi.org/10.1016/j.acra.2021.01.032

Boelens, R., De Wever, B., & Voet, M. (2017). Four key challenges to the design of blended learning: A systematic literature review. *Educational Research Review*, *22*, 1–18. https://doi.org/10.1016/j.edurev.2017.06.001

Burns, C. L., Taubert, S. T., Ward, E. C., McCarthy, K. A., & Graham, N. (2021). Speech–language therapists' perceptions of an eLearning program to support training in videofluoroscopic swallow studies. *International Journal of Language & Communication Disorders*, *56*(2), 257–270. https://doi.org/10.1111/1460-6984.12594

Chan, M., & Cheng, P. (2017). A comparison of two rating protocols for videofluoroscopic swallowing study by inexperienced judges. *International Journal of Speech-Language Pathology*, *19*(6), 562–568. https://doi.org/10.1080/17549507.2016.1254681

Clayton, N. A., Carnaby, G. D., Peters, M. J., & Ing, A. J. (2014). Impaired laryngopharyngeal sensitivity in patients with COPD: The association with swallow function. *International Journal of Speech-Language Pathology*, *16*(6), 615–623. https://doi.org/10.3109/17549507.2014.882987

Daniels, S. K., Huckabee, M., & Gozdzikowska, K. (2019). *Dysphagia following stroke* (3rd ed.). Plural Publishing.

Daniels, S. K., Schroeder, M. F., McClain, M., Corey, D. M., Rosenbek, J. C., & Foundas, A. L. (2006). Dysphagia in stroke: Development of a standard method to examine swallowing recovery. *Journal of Rehabilitation Research and Development*, *43*(3), 347–356. https://doi.org/10.1682/JRRD.2005.01.0024

Duivestein, J., & Gerlach, A. (2011). Developing clinician expertise in paediatric dysphagia: What is an effective learning model? *International Journal of Therapy and Rehabilitation*, *18*(3), 130–138. https://doi.org/10.12968/ijtr.2011.18.3.130

Edwards, A., Froude, E., Carding, P. N., Sharpe, G., & Dark, L. (2019, June 2–5). Expert opinions regarding the factors that influence videofluoroscopy training [Oral Poster Presentation]. Engaging, Collaborating, Empowering: Conference Program and Abstracts of the Joint Speech Pathology Australia National Conference and New Zealand Speech-Language Therapists Association, 81–81.

Edwards, A., Froude, E., Sharpe, G., & Carding, P. (2021). Training for videofluoroscopic swallowing analysis: A systematic review. *International Journal of Speech-Language Pathology*, *23*(5), 529–539. https://doi.org/10.1080/17549507.2020.1861327

Fabriz, S., Mendzheritskaya, J., & Stehle, S. (2021). Impact of synchronous and asynchronous settings of online teaching and learning in higher education on students' learning experience during COVID-19. *Frontiers in Psychology*, *12*, 733554. https://doi.org/10.3389/fpsyg.2021.733554

Gosa, M. M., Suiter, D. M., & Kahane, J. C. (2015). Reliability for identification of a select set of temporal and physiologic features of infant swallows. *Dysphagia*, *30*(3), 365–372. https://doi.org/10.1007/s00455-015-9610-9

Huckabee, M., & Lamvik-Gozdzikowska, K. (2018). Reconsidering rehabilitation for neurogenic dysphagia: Strengthening skill in swallowing. *Current Physical Medicine and Rehabilitation Reports*, *6*(3), 186–191. https://doi.org/10.1007/s40141-018-0193-x

IBM Corp. (2020). *IBM SPSS Statistics for Windows (Version 27.0)*. [Computer software]. IBM Corp.

Kemp, N., & Grieve, R. (2014). Face-to-face or face-to-screen? Undergraduates' opinions and test performance in classroom vs. online learning. *Frontiers in Psychology*, *5*, 1278. https://doi.org/10.3389/fpsyg.2014.01278

Kintu, M., Zhu, C., & Kagambe, E. (2017). Blended learning effectiveness: The relationship between student characteristics, design features and outcomes. *International Journal of Educational Technology in Higher Education*, *14*(1), 7. https://doi.org/10.1186/s41239-017-0043-4

Loes, C. N. (2022). The effect of collaborative learning on academic motivation. *Teaching and Learning Inquiry*, *10*, 17. https://doi.org/10.20343/teachlearninqu.10.4

Martin-Harris, B., Brodsky, M. B., Michel, Y., Castell, D. O., Schleicher, M., Sandidge, J., Maxwell, R., & Blair, J. (2008). MBS measurement tool for swallow impairment—MBSImP: Establishing a standard. *Dysphagia*, *23*(4), 392–405. https://doi.org/10.1007/s00455-008-9185-9

Moore, F. (2017). Peer-led small groups: Are we on the right track? *Perspectives on Medical Education*, *6*(5), 325–330. https://doi.org/10.1007/s40037-017-0370-0

Morgan, D. D., Litster, C., Winsall, M., Devery, K., & Rawlings, D. (2021). It's given me confidence": A pragmatic qualitative evaluation exploring the perceived benefits of online end-of-life education on clinical care. *BMC Palliative Care*, *20*(1), 57. https://doi.org/10.1186/s12904-021-00753-y

Newman, R., & Nightingale, J. (2012). *Videofluoroscopic review of swallowing: biomechanics, physiology, and pathology* [film]. Plural Publishing.

Nkhoma, M., Sriratanaviriyakul, N., & Quang, H. L. (2017). Using case method to enrich students' learning outcomes. *Active Learning in Higher Education*, *18*(1), 37–50. https://doi.org/10.1177/1469787417693501

Nordin, N. A., Miles, A., & Allen, J. (2017). Measuring competency development in objective evaluation of videofluoroscopic swallowing studies. *Dysphagia*, *32*(3), 427–436. https://doi.org/10.1007/s00455-016-9776-9

Northern Speech Services. (2021). *What is the MBSImP™ approach?* https://www.northernspeech.com/mbsimp/

Riojas, M. C. (2007). *Analysis of a developed videofluoroscopic training program to increase videofluoroscopic assessment performance* [Doctoral dissertation]. ProQuest Dissertations & Theses. Texas A&M University.

Rosenbek, J. C., Robbins, J. A., Roecker, E. B., Coyle, J. L., & Wood, J. L. (1996). A penetration-aspiration scale. *Dysphagia*, *11*(2), 93–98. https://doi.org/10.1007/BF00417897

Royal College of Speech and Language Therapists. (2014). *Dysphagia Training & Competency Framework*. https://www.rcslt.org/wpcontent/uploads/media/dysphagia-training-and-competency-framework-2014-pdf.pdf

Silbergleit, A. K., Cook, D., Kienzle, S., Boettcher, E., Myers, D., Collins, D., Peterson, E., Silbergleit, M. A., & Silbergleit, R. (2018). Impact of formal training on agreement of videofluoroscopic swallowing study interpretation across and within disciplines. *Abdominal Radiology*, *43*(11), 2938–2944. https://doi.org/10.1007/s00261-018-1587-z

Speech Pathology Australia. (2012). *Dysphagia clinical guidelines*. https://www.speechpathologyaustralia.org.au/SPAweb/Members/Clinical_Guidelines/

Stoeckli, S. J., Huisman, T. A. G. M., Seifert, B., & Martin-Harris, B. J. W. (2003). Interrater reliability of videofluoroscopic swallow evaluation. *Dysphagia*, *18*(1), 53–57. https://doi.org/10.1007/s00455-002-0085-0

Taubert, S. T., Burns, C. L., Ward, E. C., McCarthy, K. A., & Graham, N. (2021). Speech-language pathology managers' perceptions of a videofluoroscopic swallow study eLearning programme to support training and service delivery. *International Journal of Speech-Language Pathology*, *23*(1), 103–112. https://doi.org/10.1080/17549507.2020.1726465

Versteeg, M., van Blankenstein, F. M., Putter, H., & Steendijk, P. (2019). Peer instruction improves comprehension and transfer of physiological concepts: A randomized comparison with self-explanation. *Advances in Health Sciences Education*, *24*(1), 151–165. https://doi.org/10.1007/s10459-018-9858-6