THE DEVELOPMENT OF AN INTERACTIVE SELF-TRAINING SYSTEM FOR DYSPHAGIA MANAGEMENT

BY

NATRAH AHMAD NORDIN

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ABSTRACT

Speech-language therapy students are required to meet specific competency standards for entry-level practice outlined by the national professional body. Proficiency in conducting clinical swallowing examinations (CSE) and interpreting instrumental evaluations is also essential for the effective management of patients with dysphagia. However, few studies from both developed and less developed countries suggest that proficiency and confidence in this area, particularly among newly qualified speech-language therapists (SLTs), may still be developing despite they have undergone both classroom-based instruction and supervised clinical experience. Based on these notions, additional training methods are therefore needed to supplement the existing training methods and to support further skill development. To address these training challenges, this study has developed an interactive self-training system for dysphagia (ISD), which incorporate the use of simulated learning environment (SLE). The study adopted the ADDIE (Analysis, Design, Development, Implementation, and Evaluation) instructional design model. The study was structured into three phases: (1) needs analysis (2) design, development, and implementation of the ISD, and (3) evaluation of the ISD's effectiveness. In Phase I, a survey was developed and administered to 11 clinical educators. The objectives of this phase were to identify common clinical incompetencies among students during dysphagia training and to explore Malaysian clinical educators' knowledge and perceptions regarding the use of SLEs. Findings highlighted that students demonstrated the greatest difficulties in Fiberoptic Endoscopic Evaluation of Swallowing (FEES) interpretations and management planning, particularly in applying reasoning skills and integrating theoretical knowledge into clinical practice. In Phase II, the ISD was designed based on the findings from Phase I. The system was then developed, and both its content and materials underwent validation by five clinical educators. Both content and materials of ISD showed high validity and the ISD content was subsequently refined based on validators' feedback. During the implementation, five SLTs reviewed the ISD and verified its readiness for utilization. In Phase III, the effectiveness of the ISD and classroom-based learning was compared. Ten final-year undergraduate speech-language therapy students participated in the evaluation, with five students assigned to classroom-based training and five to ISD training. Results from the non-parametric analysis indicated that both groups demonstrated improvement in their post-test evaluations although the results did not reach significant. In the final phase, perceptual scores for confidence, attention, satisfaction, and relevance were equivalent across both training groups, while the System Usability Scale indicated high usability of the ISD. Nonetheless, expert reviewer identified several technical and content-related limitations that require further refinement. In conclusion, with appropriate amendments, the ISD demonstrates considerable potential as a supplementary tool for dysphagia training in undergraduate programs.

خلاصة البحث

أن من المهم أن يحقق الطلبة المبتدئين الكفاءة المطلوبة لممارسة مهنة علاج الأمراض المتعلقة بالنطق واللغة، وذلك حسب معاير الهيئة المهنية الوطنية. وتُعَدّ القدرة على إجراء الفحوصات السريرية للبلع وتفسير التقييمات الآلية شرطاً أساسياً للتعامل بفعالية مع مرضى عُسر البلع. غير أنّ عدداً محدوداً من الدراسات في كلٍّ من الدول المتقدمة والنامية يشير إلى أنّ الكفاءة في هذا المجال، ولا سيما لدى اختصاصيي علاج النطق واللغة حديثي التخرّج، لا تزال في طور التشكّل رغم تلقيهم تعليماً نظرياً وتدريباً سريرياً. وبناءً على ذلك، تبرز الحاجة إلى تطوير أساليب تدريب إضافية تُكمل البرامج التعليمية الحالية وتدعم تنمية المهارات العملية. ولمواجهة هذه التحديات التدريبية، طوّرت هذه الدراسة نظام تدريب ذاتي تفاعلي لعُسر البلع (ISD) يعتمد على بيئة تعليمية مُحاكاة (SLE). وقد استندت الدراسة إلى نموذج التصميم التعليمي (ADDIE) الذي يشمل خمس مراحل: التحليل، التصميم، التطوير، التنفيذ، والتقييم. وجاء بناء الدراسة في ثلاث مراحل رئيسة: تحليل الاحتياجات، وتصميم وتطوير وتنفيذ نظام ISD، ثم تقييم فاعلية النظام. في المرحلة الأولى، صُمِّم استبيان ووزِّع على (11) من المشرفين السريريين بهدف تحديد أوجه القصور السريرية الشائعة لدى الطلاب أثناء تدريبهم على التعامل مع عُسر البلع، إضافة إلى استكشاف معرفة المشرفين الماليزيين وإدراكهم لاستخدام بيئات التعلم المحاكاة. وأظهرت النتائج أنّ أكثر الصعوبات شيوعاً تمثلت في تفسير نتائج التقييم المنظاري الليفي للبلع ووضع خطط العلاج، خصوصاً فيما يتعلّق بتطبيق مهارات التفكير الاستدلالي وربط المعرفة النظرية بالممارسة السريرية. في المرحلة الثانية، جرى تصميم نظام ISD استناداً إلى نتائج المرحلة الأولى، ثم تطويره والتحقق من صحة محتواه ومواده من قبل خمسة مشرفين سريريين. وأظهرت عملية التحقق مستوى عالٍ من الصلاحية، وتمت مراجعة المحتوى وتنقيحه استناداً إلى ملاحظات الخبراء. وخلال التنفيذ، قام خمسة اختصاصيي علاج نطق ولغة بمراجعة النظام والتأكد من جاهزيته للتطبيق. أما في المرحلة الثالثة، فقد أُجري اختبار تجريبي للمقارنة بين فاعلية نظام ISD والتعلم الصفي التقليدي. وشارك في التقييم عشرة طلاب جامعيين في السنة النهائية من برنامج علاج النطق واللغة، حيث وُزِّعوا عشوائياً بواقع خمسة طلاب للتدريب الصفي وخمسة للتدريب عبر نظام ISD. وأظهرت نتائج التحليل أنّ كلا المجموعتين أحرزتا

تقدماً ملحوظاً في اختبارات ما بعد التدريب، إلا أنّ الفروق بين المجموعتين لم تصل إلى مستوى الدلالة الإحصائية. كما أظهرت نتائج التقييم الإدراكي لمستويات الثقة والانتباه والرضا والملاءمة تقارباً بين المجموعتين. وأشارت نتائج مقياس قابلية الاستخدام للنظام إلى ارتفاع مستوى سهولة استخدام نظام ISD. ومع ذلك، سجّل بعض الخبراء مراجعات تقنية وفي المحتوى تستلزم مزيداً من التحسينات. الخاتمة: تُظهر نتائج هذه الدراسة أنّ نظام التدريب الذاتي التفاعلي لعُسر البلع (ISD) يتمتع بإمكانات واعدة كأداة مساندة في برامج البكالوريوس لتأهيل طلاب علاج النطق واللغة، شريطة إجراء التعديلات التقنية وتعديلات في المحتوى.

APPROVAL PAGE

The thesis of Natrah binti Ahmad Nordin has been approved by the following:

Asst. Prof. Dr. Nor Azrita Mohamed Zain
Main Supervisor

Prof. Dr. Ahmad Aidil Arafat Dzulkarnain
Co-supervisor 1

Dr. Norsila Abdul Wahab
Co-supervisor 2

Asst. Prof. Dr. Rahayu Mustaffa Kamal
Internal Examiner

Assoc. Prof. Dr. Shobha Sharma
External Examiner

Assoc. Prof. Dr. Sanisah Saidi
Chairman

DECLARATION

I hereby declare that this thesis is the result of my own investigations, except where otherwise stated. I also declare that it has not been previously or concurrently submitted as a whole for any other degrees at IIUM or other institutions.

Natrah Ahmad Nordin

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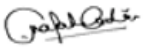

Signature

04/09/2025

Date

This thesis is dedicated to my beloved parent, my husband and my children for their love, patience and inspiration.

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LIST OF ABBREVIATIONS

3PK	Special Education Service Centre
ANOVA	One-way analysis of Variance
ASHA	American Speech-Language-Hearing Association
CA	Cervical Auscultation
CASLPA	Speech-Language and Audiology Canada
CBL	Case-based Learning
C-BOS	Competency-Based Occupational Standards
COMPASS	Competency Assessment in Speech Pathology
CVA	Cerebrovascular Accident
CVI	Content Validity Index
ELT	Experiential Learning Theory
EMG	Electromyography
ENT	Ear, Nose and Throat Department
FEES	Fiberoptic Endoscopic Evaluation of Swallowing
HLE	Hyolaryngeal Excursion
ICF	International Classification of Functioning, Disability and Health
I-CVI	Item level CVI
IIUM	International Islamic University Malaysia
IMMS	Instructional Material Motivation Survey
IREC	IIUM Research Ethics Committee
ISD	Interactive Self-Training System for Dysphagia
KKM	Kementerian Kesihatan Malaysia
MASH	Malaysian Association of Speech-Language & Hearing
MQA	Malaysian Qualifications Agency
NG	Nasogastric
OME	Oral Motor Exercise/Oral Motor Examination
PBL	Problem-based Learning
RCSLT	Royal College of Speech-Language Therapists
RM-ANOVA	Repeated Measured ANOVA
SASMEC	Sultan Ahmad Shah Medical Centre
SASRC	SASMEC Research Committee
S-CVI	Scale level CVI
SLE	Simulated Learning Environment
SLP	Speech-Language Pathologist
SO	Specific objective
SOP	Standard Operating Procedure
SP	Standardized Patient
SPSS	Statistical Package for the Social Sciences
SUS	System Usability Scale
VFSS	Videofluoroscopic Swallowing Study
VP	Virtual Patient

LIST OF SYMBOLS

<	Smaller than
>	Larger than
%	Percent
α	Alpha
β	Beta
=	Equal to
:	Ratio to
r	Correlation coefficient
≥	Larger or equal than
≤	Smaller or equal than
n	Sample size
p	Significance value
d	Cohen's d
g	Normalized gain
Z	Z-score

CHAPTER ONE

INTRODUCTION AND OVERVIEW

1.1 INTRODUCTION TO THE CHAPTER

This chapter provides an overview of the research background. In the first section, dysphagia management by speech-language therapists (SLTs) and the challenges encountered in their training are discussed. Subsequently, potential solutions for shortcomings in dysphagia management training are reviewed. The concluding section of this chapter highlights the importance of the study and outlines the structure of the thesis.

1.2 BACKGROUND OF THE STUDY

1.2.1 Overview of Dysphagia and Challenges in Clinical Training

Dysphagia is a swallowing disorder involving the oral cavity, pharynx, esophagus, or gastroesophageal junction and may occur across the lifespan due to neurological, structural, or developmental causes (Yang et al., 2023). In most clinical settings, the management of dysphagia is acknowledged as a key responsibility of SLTs (American Speech-Language-Hearing-Association [ASHA], 2016, 2020; Royal College of Speech and Language Therapist, 2023). The role of SLTs in dysphagia patient management includes conducting assessment, diagnosing, and providing rehabilitation for the population (ASHA, 2020). Timely intervention in the management of dysphagia is crucial to avoid potential consequences that may lead to a decline in quality of life (Ekberg et al., 2002) and, in severe cases, even mortality (Bakhtiyari et al., 2015; Guyomard et al., 2009; Ney et al., 2009). Consequently, possessing adequate skills significantly enhances treatment outcomes.

Given that SLTs are the professionals responsible for managing dysphagia, significant efforts have been made to establish competency in this area. The curriculum on dysphagia was first introduced into speech therapy programs in the 1990s (Miller &

Groher, 1993) and has since then evolved. In 2020, ASHA has mandated competency in dysphagia management for certification, emphasizing the critical importance of this skill. This requirement highlights the increasing attention and the critical importance of this skill. A strong correlation between SLTs' perceptions of their abilities and their actual performance skills has been reported (Pasupathy & Bogschutz, 2013). Unfortunately, the confidence of new SLTs for managing dysphagia cases, remains suboptimal (Caesar & Kitila, 2020; Singh et al., 2015; Urban & Hazelwood, 2019). The lack of confidence is also reported among SLTs in Malaysia (Mustaffa Kamal et al., 2012b). Some SLTs feel their entry-level education does not adequately prepare them for dysphagia management, though this may differ across countries depending on training program structures (Caesar & Kitila, 2020; Singh et al., 2015). In Turkey, for example, SLTs reported that their entry-level education adequately prepared them for practice; however, opportunities to manage such cases were limited within the country (Gölaç, İncebay, & Esen Aydınlı, 2022).

Various factors could potentially contribute to the challenges observed in clinical education for dysphagia management. Although speech-language therapy was established in the 1920s, dysphagia was not formally integrated into the field until around late 1980s with very few experts. (Duchan, 2002; Miller & Groher, 1993). The shortage of available qualified clinicians also leads some clinicians and/or institutions to decline student placements, thereby significantly limiting students' opportunities to gain practical experience (Singh et al., 2015). Additionally, the increasing number of students in speech-language therapy programs exacerbates the difficulty of securing clinical placements (Joginder Singh et al., 2020; Sheepway et al., 2011; Ward et al., 2014). With more students competing for limited placement opportunities, it becomes even more challenging to provide adequate hands-on training in dysphagia management. The limited availability of clinical supervisors or staff also leads clinicians and/or institutions to decline students, significantly impacting students' opportunities to gain practical experience (Joginder Singh et al., 2020; McAllister, 2005; Ward et al., 2014), which is essential for building competency in dysphagia management. Other than that, the limitation of funding from the institution could affect the clinical education generally (Joginder Singh et al., 2020).

1.2.2 Potential Solution for Dysphagia Training Shortcomings

In order to overcome the limitations in dysphagia training, educators in the field of speech-language therapy have been exploring advanced educational approaches such as problem-based learning (PBL) (Burda & Hageman, 2015; Erickson & Serry, 2016), peer-assisted learning (Burda et al., 2022; Catania et al., 2024; Sheepway et al., 2011), and extended clinical supervision (Wagner & Malandraki, 2016). Nevertheless, these approaches still require guidance and supervision. With the increasing popularity of simulation-based training in medicine, nursing and audiology (Dzulkarnain et al., 2015; Henneman et al., 2010; Okuda et al., 2009), SLT educators have also been investigating its potential in speech-language therapy (Doytchinova & Yellan, 2021; Hill et al., 2021; Macbean et al., 2013; Ward et al., 2014). Simulation-based training has been demonstrated to be a reliable method for enhancing students' clinical skills. Additionally, it lowers stress levels among students and equips them for actual clinical tasks by providing them with the opportunity to practice in a controlled environment (Miles et al., 2016). It also allows for the modification of clinical situations and the evaluation of students in identical circumstances (Alinier, 2011).

Dudding and Nottingham (2018) reported that the most commonly used forms of simulation in speech-language therapy programs in universities in the United States are standardized patient simulations and computer-based simulations. While the use of standardized patients has been well established over time, the growing popularity of computer-based simulations during their study may have been influenced by the availability of commercially accessible software, such as SimuCase™ (Dudding & Nottingham, 2018). More recently, due to changes in program certification standards and the impact of the COVID-19 pandemic on clinical education, computer-based simulations have become increasingly prevalent (Dudding, Zraick, & Dudding, 2024). Despite its potential, research on computer-based simulations in speech-language therapy and its efficacy are still limited (Carter, 2019; Okopal, 2019) and in the domain of dysphagia specifically (Bryan, 2022). To our knowledge, existing published studies on dysphagia computer-based simulations have primarily focused on specific aspects such as history-taking skills (Sia et al., 2016), pediatric feeding and swallowing management (Ferguson & Estis, 2018) and also a combination of CSE and videofluoroscopic swallow study (VFSS ; Bryan, 2022). Considering the popularity of fiberendoscopic evaluation of swallowing (FEES) as the instrument of choice among

Malaysian SLTs (Mustaffa Kamal et al., 2012a), this study aimed to develop an interactive self-learning system specifically for dysphagia patient management, focusing on CSE and FEES interpretation called the ISD. This system was developed to supplement dysphagia education and enhance clinical training opportunities for Malaysian SLT students.

1.3 SIGNIFICANCE OF STUDY

The present study is significant for several compelling reasons. In speech-language therapy, specifically in Malaysia, the utilization of simulation studies is still in its infancy. The development of an interactive self-learning system for dysphagia marks a notable advancement in the training of SLT students in the country. From a practical perspective, the ISD provides an innovative complement to classroom-based training methods. As a computer-based interactive system, it introduces a novel approach to dysphagia management training. Moreover, the ISD serves as an additional training resource that can be utilized anytime and anywhere, offering greater flexibility and accessibility for students.

Additionally, integrating technology into education reflects a continuing shift in medical and health sciences education toward innovative and evidence-based teaching methods (Gaba, 2004). This study aimed to enhance the educational experience of dysphagia patient management by integrating Case-based Learning (CBL) and a computerized system within the ISD. Previous study has shown that the application of CBL could provide deep learning and promote retention of knowledge (Doeltgen et al., 2019). The use of ISD as part of student training may improve students' readiness before the real clinical practice. In addition, the ISD system enables student to practice repeatedly, receive immediate feedback, and refine their clinical decision making without risk to actual patients (Alinier, 2011; Jones et al., 2015).

Overall, the development and implementation of the ISD shall contribute to substantial advantages in the field of speech therapy education, particularly in dysphagia management training. This current PhD study enhances the field by offering an supplementary training tool that may enhance student learning outcomes, improve clinical decision making, and better equip future SLTs for the demand of the profession.

1.4 THE STRUCTURE OF THE THESIS

This thesis is organized into seven chapters. Chapter 1, the current chapter, provides a general overview of the study. It addresses the shortcomings in dysphagia management and training in SLT and discusses potential solutions for these issues. Additionally, this chapter explains the rationale for the study and highlights the significance of the research.

Following this is the literature review. Chapter 2 discusses in detail the roles of SLTs in dysphagia management, the previous and current state of dysphagia education and training, and the availability of simulated learning environments for dysphagia. Additionally, it explains the theoretical framework underlying the study.

Chapter 3 highlights the problem statement and explains the study's objectives, hypotheses, and the research phases.

Chapter 4 focuses on the first phase, which involves a needs analysis. A survey was conducted to identify the types of clinical incompetencies among students. The survey's content helps determine the suitable content and material for Phase 2.

Chapter 5 covers the second phase, which involves designing and developing the interactive self-training system for dysphagia (ISD). This chapter also discusses the development process and the validation of the ISD by experts.

The last phase, which assesses the effectiveness of the ISD, is addressed in Chapter 6. Ten final-year SLT undergraduates were divided into two groups: one received classroom-based training, while the other utilized the ISD. Pre- and post-intervention assessments were conducted to examine the differences in gain scores and gather feedback on the ISD.

Finally, Chapter 7 presents the summary, limitations, and possible future recommendations.

CHAPTER TWO

LITERATURE REVIEW

2.1 INTRODUCTION

This chapter provides a comprehensive overview of dysphagia, including its prevalence, effects, and the roles of SLTs in the management of dysphagia patients. Following this, the discussion will focus on the concerns related to dysphagia entry education training for SLTs. The chapter continues with discussions regarding computer-based simulation and simulated learning environments (SLE) in speech-language therapy training, with a particular emphasis on dysphagia. The final section of this chapter elaborates on the theory and framework associated with the research.

2.2 DYSPHAGIA

According to International Classification of Functioning, Disability and Health (ICF), swallowing is a process where substances such as food, drink and saliva are cleared from the oral cavity to the stomach, at appropriate time and rate (World Health Organization, 2024). Swallowing is divided into four main phases: the preparatory phase, the oral phase, the pharyngeal phase, and the esophageal phase (Herbella et al., 2023). On the other hand, swallowing disorder or dysphagia occurs when there is a disruption in one or more of the various sensory-motor processes involved in normal swallowing (Humbert et al., 2009).

A recent systematic review by Rajati et al. (2022) revealed a global prevalence of dysphagia in 43.8% of the population. The prevalence of dysphagia is substantially elevated among the older population (Humbert et al., 2009; Rajati et al., 2022). The most often reported etiology for adult dysphagia was stroke, other neurological diseases, and head and neck cancer (Bhattacharyya, 2014; Leonard & Kendall, 2014; Rajati et al., 2022). Hamidon et al. (2006) noted that dysphagia was observed in as many as 65.9% of stroke patients in Malaysia. Additionally, research conducted at a dental facility at Universiti Sains Malaysia revealed that 59.1% of head and neck cancer

patients experienced dysphagia before, during, or after their treatment (Linn, Che M. Nasir & Abdul Wahab, 2015).

Dysphagia has significant adverse effects on individuals' health and quality of life. It can lead to malnutrition, dehydration, and aspiration pneumonia, which are particularly concerning in vulnerable populations such as the elderly, stroke survivors, and individuals with dementia (Martino et al., 2005; Smithard et al., 2007). Aspiration pneumonia is the leading cause of readmission among acute stroke patients and accounts for over 50% of deaths within the first 30 days following a stroke (Ney et al., 2009).

Furthermore, the are also psychological impacts of dysphagia include anxiety, depression, and social isolation, as patients may avoid eating in public or with family due to fear of choking or embarrassment (Ekberg et al., 2002). The high prevalence of dysphagia underscores the significance of effective management both internationally and specifically in Malaysia. Without effective management, the quality of life of individuals with dysphagia can be compromised.

2.3 SPEECH-LANGUAGE THERAPIST AND DYSPHAGIA MANAGEMENT

An SLT is recognized as primary health care personnel who is responsible to assess and manage the adult and pediatric dysphagia cases (ASHA, 2015). The management of dysphagia by SLT encompasses a multifaceted approach which includes:

1. **Swallow screening and evaluation:** "Screening" is typically performed at the bedside to identify individuals who may be at risk of dysphagia and aspiration. “Evaluation” is a comprehensive assessment conducted to diagnose dysphagia and finding the underlying cause. The clinical swallow evaluations may include gathering information about medical history and symptoms, observing oral motor function, assessing cranial nerve functions, and evaluating swallowing abilities with various food and liquid consistencies (ASHA et al., 2015; Leonard & Kendall, 2014).

2. **Instrumental assessments:** Instrumental assessments are conducted to enable SLPs making a comprehensive evaluation as well as to assist in selecting effective treatment approaches. The most common instrumental evaluations include, but are not limited to, the videofluoroscopic swallowing study (VFSS), fiberoptic endoscopic evaluation of swallowing (FEES;ASHA, 2015).

3. **Rehabilitation:** SLTs are responsible for developing individualized treatment plans based on the findings from the evaluation and instrumental assessments. Additionally, SLPs provide essential education and counseling to both patients and their caregivers. This includes guidance on texture modifications to ensure safe swallowing, instruction on effective swallowing techniques, and teaching exercises and compensatory strategies aimed at improving swallowing functions (ASHA, 2015).

2.4 FORMAL TRAINING IN DYSPHAGIA

2.4.1 Dysphagia Management Curriculum

Literature suggests that the formal involvement of SLTs in dysphagia management gained clearer definition in the 1970s, when initial protocols for assessment and intervention began to emerge (Miller & Groher, 1993). The role of SLTs in this area was explicitly acknowledged in a textbook by Logemann (1997), and by the late 1990s, dysphagia content had begun to be incorporated into some university-level speech-language therapy training programs (Miller & Groher, 1993).

Several initiatives have been undertaken to establish a comprehensive dysphagia curriculum within the field of speech-language therapy. The establishment of policy makers for postgraduate dysphagia training in Britain occurred in 1992 under the auspices of the Royal College of Speech-Language Therapists (RCSLT) (Perry, 1999). As the professional body representing speech and language therapy professionals and students, the RCSLT is responsible for recommending appropriate courses for both academic and clinical training. The RCSLT developed a Training and Competency Framework for SLTs based on their level of expertise and to establish service standards

(RCSLT, 2014). Conversely, ASHA (2007) provides the Graduate Curriculum on Swallowing and Swallowing Disorders (which includes both adult and pediatric dysphagia) on their website to assist universities in the creation of graduate training programs. This guideline presented an all-inclusive inventory of the subtopics and their relevant references (ASHA, 2007). Australia's progress in dysphagia management is quite comparable to that of the United States and Britain. In 1994, Speech Pathology Australia created the Competency-Based Occupational Standards (C-BOS) which outlined the minimum requirements for dysphagia management in their graduate programs (Perry, 1999). Despite the existence of guidelines, variations were reported at the time among Australian universities in areas such as the timing of dysphagia course delivery and the use of standard VFSS teaching guides (Perry, 1999).

2.4.2 Theory and Practical Training

Traditionally, speech-language therapy students are trained didactically (e.g., lecture, notes) before they are exposed to clinical setting (e.g., observation, clinical placement). Didactic training is a theoretical basis learning where students were given information on what they needed to know by a teacher or an educator (Entwistle, 1997). The most common instructional approach utilized to teach foundational knowledge and concepts, particularly to a larger cohort of students, is lecturing (Zhao et al., 2020). Logemann (1997) proposed that undergraduate students should get theoretical classes on dysphagia management for a minimum duration of one semester. Following didactic training, students are usually tested in written or oral examinations. These kinds of examinations are determined to measure factual recall of the information given (Entwistle, 1997). Written examinations on the other hand, were criticized for only evaluating students' data memorization while practical sessions allow training and evaluation of students' clinical solving skills (Bullen, 1997). Hence, practical sessions have been a custom in healthcare training including in speech-language therapy programs. This is referred to as 'practice-based learning', when practical experience is gained in clinical settings with actual patients (Lekkas et al., 2007). During practical sessions, students apply their theoretical knowledge in practice and learn to perform as professional practitioners (Rodger et al., 2008; Sheepway et al., 2011).

In general, graduates in speech-language therapy are required to complete a specified number of clinical practicum hours. According to ASHA's *Certification Standards for Speech-Language Pathology Clinical Practicum* (ASHA, n.d.), patient contact hours for specific cases or topics are not mandated. However, individual programs may establish their own requirements to ensure adequate depth and breadth of experience across various clinical areas. ASHA (n.d.) recommends a minimum of 325 hours of clinical practicum as the baseline requirement for certification. Nevertheless, according to the Canadian Association of Speech-Language Pathologists and Audiologists (2015), it is mandated in Canada that graduates must complete a minimum of 10 hours of supervised dysphagia cases under the supervision of experienced SLTs. In the Australian context, Perry (1999) reported that universities at that time provided between 18 and 40 hours of training in dysphagia, of which two to six hours were allocated to VFSS. However, the study did not specify whether these hours represented theoretical instruction, practical training, or a combination of both. A later study by Mustaffa Kamal et al. (2012b) indicated that all SLTs in Queensland, Australia, completed a semester-long dysphagia course averaging 42.1 hours, which incorporated both theoretical and practical components.

Comparable variation has been reported in other contexts. Another study conducted among South African universities found that training in adult dysphagia management ranged from 12 to 59 hours of theoretical instruction and 3.5 to 40 hours of practical training (Singh et al., 2015). Additionally, Caesar and Kitila (2020) discovered that more than half of the ASHA-certified SLTs received training through at least one course and completed at least one externship program for dysphagia. However, the study did not specify the number of hours dedicated to the externship program. Overall, these findings indicate considerable variation across countries in the number of hours dedicated to dysphagia education and in the balance between theoretical and practical instruction.

2.4.3 Current Formal Education and Training on Dysphagia in Malaysia

Speech-language therapy has only been formally established as a discipline in Malaysia in recent decades. The service was originally introduced in this country by the American Peace Corps and British Voluntary Service in the 1960s (Malaysian Association of

Speech-Language & Hearing [MASH], 2016). In Malaysia throughout the 1980s, the number of SLTs providing treatment was fewer than 10 (Ahmad et al., 2013). There is a collective count of 156 SLTs employed in government (Sarno, Tukiran & Wan Ahmad, 2024), 52 in universities and teaching hospitals (Tukiran, 2023), eight in the Special Education Service Centre (3PK) (Malaysia Ministry of Education, 2020), and 211 operating in private practice (MASH, 2023). Roughly in 2023, Malaysia possesses over 427 SLPs. However, it is anticipated that the actual count of SLTs would be higher, as there may be some who are not officially registered. Moreover, the therapist-to-individual ratio in the country is still low at 1:209,615, whereas the United States has a ratio of 57.7 therapists per 100,000 persons (Malaysia Ministry of Health [MOH], 2023).

The majority of SLTs in Malaysia mostly work with pediatric populations rather than adults (Mustaffa Kamal et al., 2012). Nevertheless, as the number of SLTs has grown over time and with health workers awareness about dysphagia treatment by SLTs increasing, it is expected that the referral and management of dysphagia cases will continue to increase (Hussain et al., 2022; Mustaffa Kamal et al., 2013). Given the importance of effective dysphagia treatment, it is crucial to ensure that SLTs are capable of delivering successful care. Still, the implementation of effective dysphagia treatment in Malaysia has been an uphill climb. The primary limitation to the optimal implementation of evidence-based practice in dysphagia treatment by SLTs is the scarcity of manpower in this country.

Several initiatives were undertaken to increase the quantity of SLTs. The speech-language therapy program was initially created in Malaysia at the University Kebangsaan Malaysia in 1995. Subsequently, the speech-language therapy program was established at Universiti Sains Malaysia in 2005 and at the International Islamic University Malaysia in 2016. The Malaysian Qualifications Agency (MQA) is responsible for ensuring the quality of all programs in public and private universities, in line with international standards. As stated by MQA (2016), to complete their SLT degree, graduates must fulfil a requirement of 200 direct contact clinical hours. Nevertheless, the MQA does not provide specific guidelines regarding the allocation of hours for various sorts of cases.

A comparison of the dysphagia course syllabus across three universities offering speech-language therapy programs in Malaysia (personal communication with

university representatives, dated 26th February 2025) revealed several similarities and differences as portrayed in Table 2.1 below:

Table 2.1 A comparison of course syllabus for dysphagia across three universities in Malaysia

Details		**University A**	**University B**	**University C**
Credit unit		2	3	3
Year offered/Semester		Third Year/Semester II	Fourth Year/ Semester I	Fourth Year/ Semester 1
Summary of the learning outcomes		The course emphasizes theoretical knowledge of anatomy and swallowing mechanisms, clinical reasoning in selecting appropriate assessment methods and treatment options, and procedural skills in administering assessments and treatment for feeding and swallowing disorders.	The course emphasizes theoretical knowledge of anatomy and swallowing mechanisms, clinical reasoning in selecting appropriate assessment methods and treatment options, and procedural skills in administering assessments and treatment for feeding and swallowing disorders.	The course emphasizes theoretical knowledge of anatomy and swallowing mechanisms, clinical reasoning in selecting appropriate assessment methods and treatment options, and procedural skills in administering assessments and treatments for swallowing disorders across all ages, as well as related disorders.
Content/Topic	Anatomy and physiology of swallowing	√	√	√
	Swallowing disorders	√	√	√
	Clinical assessment for swallowing (Clinical	√	√	√

	Swallowing Examination; CSE)			
	Clinical assessment for swallowing (Instrumental swallowing assessments)	√	√	√
	Interpretation of VFSS		√	
	Intervention for swallowing disorders (Compensatory)	√	√	√
	Intervention for swallowing disorders (Rehabilitation)	√	√	√
	Intervention for swallowing disorders (Medical)			√
	Anatomy of feeding and feeding development	√	√	√
	Assessment of feeding disorders	√	√	√

	Treatment of feeding disorders	√	√	√
Teaching Method	Lecture	√	√	√
	Tutorial	√	√	√
	Practical	√	√	√
	Discussion	√	√	√
	Case Study	√	√	√
Assessment Method	Essay/Quiz	20%	10%	
	Assignment/Report		20%	20%
	Presentation			20%
	Practical	20%	30%	10%
	Discussion	20%		
	Final Exam	40%	40%	50%

First, the credit weighting for the dysphagia course was consistent between two of the universities, each assigning three credits, whereas University A assigned only two credits. According to MQA (2016), a minimum of three credits is required for the dysphagia course. Second, the timing of course delivery varied: at University A, the dysphagia course was offered in the third year of the program, while in the other two universities, it was scheduled during the fourth year. This variation may provide insight into the issue raised by Singh et al. (2015), who reported that dysphagia training often involves an extended gap between theory and practice. However, this concern may be less relevant in the Malaysian context, where students are generally expected to manage dysphagia cases during their clinical placements in the third or fourth year, aligning more closely with the timing of theoretical instruction (IIUM Speech-Language Pathology Clinic 6 Outline, 2013; IIUM Speech-Language Pathology Clinical Placement Outline, 2023). Third, all three universities aimed to develop both higher-order theoretical knowledge related to the anatomy and physiology of swallowing, as well as psychomotor skills relevant to dysphagia management, as reflected in their course learning outcomes. Psychomotor skills refer to the ability of students to translate cognitive understanding into clinical practice across various contexts in order to deliver effective patient care (Bourassa et al., 2024). Accordingly, the current syllabus in all three universities is designed to integrate both theoretical instruction and applied learning activities, including tutorials, hands-on practical, group discussions, and case-based learning. This approach is also in line with the MQA (2016) guideline, which stipulates that 0.5 credit should be allocated to practical components.

Other than that, while the overall course topics and content were largely consistent among the universities, differences were noted in the teaching of instrumental assessments. University A provided a general overview of procedures such FEES, VFSS, ultrasound, and manometry. In contrast, University B specified a dedicated tutorial focused on VFSS interpretation. University C did not provide detailed information regarding instrumental assessments in its course documentation. In addition, University C uniquely included a subtopic on medical interventions for swallowing disorders, which was not specifically addressed in the courses of the other two universities.

Overall, all three universities included final examinations and practical assessments, but the weightings differed: the final examination accounted for 40% of the overall grade in Universities A and B, and 50% in University C. While these figures

reflect a substantial emphasis on theoretical knowledge, the relatively lower percentage allocated to practical assessments within the course may be attributed to the fact that clinical practicum is treated as a separate and substantial component under the MQA (2016) framework. In this context, hands-on clinical competencies are often developed and assessed more extensively during dedicated practicum placements rather than within individual coursework. Nevertheless, despite exposure to both theoretical and practical components during their university training, several studies in few countries have reported that novice SLTs continue to feel underprepared and lack confidence in managing dysphagia cases upon entering clinical practice. This issue will be further discussed in the next subsection.

2.4.4 Speech-Language Therapist Dysphagia Management Perceived Competence and Confidence

As discussed earlier, it is compulsory for speech-language therapy students to reach specific competencies requirement for entry-level practice (McAllister & Lincoln, 2004). It is communal for SLTs to manage speech and language disorders, but dysphagia management competency requires specialized training from graduate or postgraduate level (ASHA, 2007). From 2014, in order to obtain ASHA certification, the organization obliges competency in dysphagia management among the SLTs. This shows that dysphagia management competency is vital and the attention on it is increasing by years.

Despite the attention and training policies and guidelines introduced for teaching dysphagia, studies reveal that many SLTs in various countries feel that their entry-level practice did not instill confidence and perceived competence (Caesar & Kitila, 2020; Mustaffa Kamal et al., 2012b). This is disconcerting because it is common for SLTs to manage dysphagia cases once graduated, particularly if they work in a hospital setting (Modi & Ross, 2000). Research conducted in five universities in South Africa found that a majority of students in three of the universities felt that their university did not adequately prepare them for dysphagia training as compared to other areas of study (Singh et al., 2015). This inadequacy was attributed to the lack of sufficient clinical opportunities provided by the universities (Singh et al., 2015). Interestingly, this perception is also prevalent among ASHA-qualified SLTs, as highlighted by the study

conducted by Caesar and Kitila in 2020. More than two-thirds of the 375 SLTs express a sense of inadequacy in their entry-level education when it comes to preparing them for managing dysphagia, particularly in pediatric cases, and conducting and interpreting FEES. Consequently, this is directly related to their level of confidence in the practice. Only after years of practice, SLTs gained increased confidence (Caesar & Kitila, 2020). This pattern is not new; an earlier study by Perry (1990) similarly found that graduates gained practical knowledge of dysphagia management primarily through learning from colleagues after entering the workforce. Additionally, workplace training and courses by employers contribute to addressing this gap (Guthrie et al., 2017). The feeling of unpreparedness for dysphagia training has also been reported among SLTs in Malaysia. SLTs have reported a lack of confidence in conducting dysphagia management following their entry-level education (Mustaffa Kamal et al., 2012b; Sharma et al., 2006). Data from Mustaffa Kamal et al. (2012b) indicated significant differences in perceived adequacy of training when compared to SLTs in Australia, particularly regarding the sufficiency of formal education in dysphagia. Australian SLTs reported receiving an average of 42 hours of dysphagia training, whereas their Malaysian counterparts received only an average of 10 hours (Mustaffa Kamal et al., 2012b). However, it is important to note that these findings may no longer reflect the current state of dysphagia education in Malaysia. As described in Section 2.4.3, the dysphagia curriculum has undergone significant improvements, including increased instructional hours, the integration of both theoretical and psychomotor components, and enhanced use of active learning strategies such as tutorials and practical sessions. These enhancements aimed to better align with the clinical competencies required in practice and to reduce the gap between academic preparation and workplace readiness.

2.4.5 Factors Contributing to Dysphagia Education Gap

Various factors contribute to the inadequacy of clinical education and training for dysphagia management in speech-language therapy programs. A key contributor is the global variation in curriculum standards for dysphagia training (ASHA, 2007; CASLPA, 2015; RCSLT, 2014), which may lead to inconsistent educational experiences and subsequently impact graduates' confidence and perceived readiness for clinical practice. The scope and depth of dysphagia training in university programs can

vary, with differences in the balance between theoretical instruction and clinical practice components. Singh et al. (2015) also emphasized that the curriculum allocates a greater amount of time to theoretical courses in South Africa. Although the discipline of speech-language therapy has experienced substantial growth in knowledge and an expansion in the range of issues covered, the recommended clinical practice hours have not increased to fully encompass all aspects of disorders, particularly dysphagia, indicating a gap between educational preparation and clinical experience (Ball & Riquelme, 2016; Scholten, 2001b; Singh et al., 2015). Conversely, in some institutions, some cases such as dysphagia may be less frequently encountered in the clinical caseload (McAllister, 2005), further limiting students' exposure and hands-on experience with patients with dysphagia.

The variation of curriculum is also influenced by the level of establishment of speech-language therapy programs in different countries (Chu et al., 2019). For instance, SLT programs are more established in countries such as the United States and Australia compared to South Africa and Malaysia (Mustaffa Kamal et al., 2012b; Perry, 1999; Singh et al., 2015). Consequently, in countries where speech-language therapy is well-established, there are more well-trained educators and better facilities, which enhance the quality of education and training available to students. However, even in more developed countries, certain aspects of dysphagia training are still lacking, potentially due to differences in clinical practice. For example, the use of VFSS is common in the USA and Australia, whereas in Malaysia, FEES is more frequently utilized (Caesar & Kitila, 2020; Mustaffa Kamal et al., 2012a). Thus, SLTs indicated that their proficiency in specific instrumental evaluation relies on their regular practice. This difference can be attributed to the typical practice settings of Malaysian SLTs, who often work in Ear, Nose, and Throat (ENT) departments, making FEES more accessible and practical for them (Ahmad et al., 2013; Mustaffa Kamal et al., 2012a).

The growing demand for speech-language therapy services has led to an increase in the number of speech-language therapy programs and students worldwide. However, this rise in student numbers has not been matched by a corresponding increase in available clinical placements (McAllister, 2005). This shortage limits opportunities for clinical training. Additionally, the shortage of qualified educators and the reluctance of many to take on supervisory roles further restricts the number of students that programs can accommodate (Joginder Singh et al., 2016; McAllister, 2005; Rodger et al., 2008). Often, due to shortage of workforce, educators were appointed solely on their

availability without sufficient training for the position (Joginder Singh et al., 2011; Rodger et al., 2008). As a result, their approach to training may be influenced more by individual clinical experience than by standardized or evidence-based teaching methods. A further constraint on the provision of comprehensive education and training in the field of speech-language therapy is the limited availability of resources (Mustaffa Kamal et al., 2015; Ward et al., 2015). These resources include financial support, essential facilities, and access to current academic materials. Again, financial constraints have a substantial effect on universities' ability to employ an adequate number of educators, which in turn limits the availability of clinical supervisors for student training (Hill et al., 2010; Rodger et al., 2008; Ward et al., 2015). This shortage restricts the number of clinical placements, and the quality of supervision students receive. Also, the field of dysphagia care frequently requires the utilization of specific instrumental assessments, such as VFSS and FEES. These examinations are usually only accessible in prominent hospitals and well-equipped medical facilities, which further restricts the practical training possibilities for students in less well-resourced places (Ball & Riquelme, 2016; Mustaffa Kamal et al., 2015).

An interesting development in the field of speech-language therapy education is the changing preferences of students regarding teaching methods. According to Ball and Riquelme (2016), the new generation of speech-language pathology students often finds traditional teaching methods to be uninspiring and ineffective. Therefore, they are looking for innovative, multimedia-based approaches to add into their teaching style in order to preserve their motivation in learning (Ball & Riquelme, 2016).

In conclusion, the overall limitation of dysphagia education in speech-language pathology programs is predominantly centered around training issues. Addressing these training-related challenges is crucial to enhance the competence and confidence of future SLTs, ensuring they are well-equipped to provide high-quality care for individuals with swallowing disorders. The potential solutions implemented by universities and stakeholders to overcome these limitations will be discussed in the next section.

2.4.6 Potential Solutions

2.4.6.1 Innovation of Clinical Placement and Supervisory Model

Considering there are challenges associated with limited staffing and the increasing number of students in speech-language therapy programs, innovation to clinical placement and supervisory models have been implemented (McAllister, 2005; Sheepway et al., 2011; Van Dort, 2005). These models offer an alternative to the traditional one-to-one supervisory approach (Rodger et al., 2008; Sheepway et al., 2011). An example of a newer supervisory model is the group supervision model, in which clinical educators supervised a small group of two to four students (Briffa & Porter, 2013). The group supervision model facilitates students in becoming less reliant on their clinical educators and instead offers an opportunity for peer-assisted learning (Rodger et al., 2008; Sheepway et al., 2011). Peer-assisted learning refers to scenarios in which students work together with their peers or more experienced individuals while carrying out clinical activities (Lekkas et al., 2007; Van Dort, 2005). It has been proven beneficial, helping students improve their confidence and increase their participation (Lekkas et al., 2007; Sheepway et al., 2011). However, this model carries the risk of disseminating inaccurate information and fostering an environment where more competent students may overshadow during learning process (Lekkas et al., 2007). While group supervision can be effective for practicing communication disorders, it may not be suitable for supervising dysphagia case management. This is because managing dysphagia patients on the other hand requires close, direct oversight (Scholten, 2001a). This is due to the complexity and potential risks involved in dysphagia management that must be 100% guarded supervision by qualified supervisors to ensure patient safety (Scholten, 2001a).

Another example of an innovative placement model that is highly supported by SLT clinical educators to address placement and student issues is the block placement model (Joginder Singh et al., 2020; Sheepway et al., 2011). In a block placement, students are assigned to the same clinical site for a predetermined duration, attending for more than two days a week. Clinical educators have reported that this model facilitates more efficient management of patient scheduling and enables more thorough supervision of students (Joginder Singh et al., 2020) . Consequently, positive outcomes

in students' competency can be observed during block placements (Sheepway et al., 2011). However, it is important to note that this model pertains to the clinical training of speech-language therapy in general. Specific considerations during placement must be made regarding the availability of targeted caseloads and competent clinical supervisors on-site to ensure targeted training achieved by students (McAllister, 2005).

2.4.6.2 Extended Dysphagia Training

To ensure that students receive adequate training, clinical educators often choose competency-based training through strategically extended clinical placements. This approach emphasizes the development of specific competencies and skills essential for effective dysphagia management. By prolonging the duration of clinical placements and thoughtfully organizing training activities, educators can offer more comprehensive and focused hands-on experience. In 2015, Graville, Palmer, and Gorsek published a paper detailing the outcomes of a series of 10 laboratory sessions specifically designed to educate speech-language therapy students in Oregon about dysphagia. During this comprehensive dysphagia lab, students received guidance from expert clinical educators to acquire knowledge on the fundamental anatomy and physiology of swallowing, as well as procedures for assessing and treating dysphagia. The results demonstrated enhanced proficiency in dysphagia-related abilities among students, as well as increased self-confidence.

Another form of extended dysphagia training was carried out among speech-language therapy students who have completed their core dysphagia course in Columbia University (Wagner & Malandraki, 2016). Wagner and Malandraki (2016) designed a prototype Dysphagia Research Clinic to train these graduate students in providing individualized dysphagia treatment to patients. The prototype Dysphagia Research Clinic was established within the university training clinic and equipped with essential instruments for dysphagia management, including a flexible endoscope for FEES. The dysphagia treatment training took place over a 6-week period and was supervised by five qualified clinicians. The overall progress can be observed by the increase of students' self-confidence, which is also associated with the improvement of skills, as evaluated by supervisors.

2.4.6.3 Problem-based Learning (PBL)

In addition to the clinical practical environment, clinical educators in speech-language therapy have also embraced an alternative approach called problem-based learning (PBL) to incorporate active learning in the classroom setting (Burda et al., 2022; Burda & Hageman, 2015; McAllister, 2005; Scholten, 2001a). PBL is an approach where a group of students working collaboratively to solve a contextually based problem (Burda & Hageman, 2015; O' Leary et al., 2023). In PBL, students are taught to engage in reflective thinking, which enables them to acquire problem-solving abilities, cultivate critical thinking skills, collaborate effectively, and learn through practical experience (Burda & Hageman, 2015; Mok et al., 2014). Typically, educators in PBL act as facilitators. Therefore, the facilitator does not necessarily need to be an expert in the subject matter (Mok et al., 2014; Whitehill et al., 2014).

PBL is utilized in speech-language therapy programs (Burda & Hageman, 2015; Mok et al., 2014; Whitehill et al., 2014) with the aim of enhancing students' understanding of learning topics through the context of a problem (Mok et al., 2014; Whitehill et al., 2014). In a more recent study, speech-language therapy students at Midwestern University in the United States were taught a dysphagia course that incorporated PBL assignments and critical thinking activities over a 15-week period (Affoo et al., 2020). The study revealed that students showed improvement in teamwork through PBL, which was also reflected in their exam performance.

Although PBL is often discussed and used as an effective method of learning, it is criticized for being potentially time-consuming (Burda & Hageman, 2015). Students might also become frustrated when trying to coordinate group schedules (Burda & Hageman, 2015) while facilitators might find it challenging to adopt an assessment method for the PBL activities (Mok et al., 2014). Furthermore, since PBL focuses on teaching students to solve problems within a specific context, it may not be well-suited for practical training that involves psychomotor activities.

2.4.6.4 Peer-assisted Learning

Another way to incorporate active learning in the classroom is through the application of peer-assisted learning. Applying the same mechanism of peer mentoring in clinical

practice (Lekkas et al., 2007; Van Dort, 2005). Burda et al. (2015) defined this type of learning as “individuals learn new things and teach them to their peers”. Peer-assisted learning can be applied through practice of new clinical skills or professional practice skills without the involvement of real patients. As an example, Burda, Brotherthon and Duitscher (2022), applied peer-assisted learning to teach cranial nerves examinations to speech-language pathology students. The students were divided into groups and instructed to alternate between the roles of clinician and patient to practice, applying an outlined script. This study has demonstrated that students have experienced enhanced understanding and increased confidence in evaluating cranial nerves functions. Through this in-class training, students are better prepared to perform effectively during their clinical practice (Burda et al., 2022).

Although the implementation of modified placement methods and training stated earlier has demonstrated numerous advantages, it has also been accompanied by particular challenges. The additional clinical placement and development of new exercises were shown to be connected with time and budgetary problems (Bryan, 2022). Other than that, most of the solutions above still require the involvement of supervisory team, whether to limited or maximal extend. Another existing, albeit temporary, obstacle is the substantial limitation of in-person clinical experiences caused by the COVID-19 pandemic (Tabatabai, 2020). As a consequence, students at that time encountered limitation to participate in hands-on learning experiences. Foreseeing the challenges with unsustainable methods of education in speech-language pathology, as well as placement and training issues, educators have begun incorporating simulated-learning environments (SLE) into speech-language therapy programs (Macbean et al., 2013). In fact, in response to these challenges, the Council for Clinical Certification (CFCC) updated the certification standards in 2016 to allow up to 75 clinical contact hours to be obtained through clinical simulation methods (ASHA, 2016). The details of SLE utilization in speech-language therapy, both in general and specifically for dysphagia training, will be discussed in the next section.

2.5 SIMULATED LEARNING ENVIRONMENT

2.5.1 Simulated Learning Environment –Definition, Types and Advantages

Simulation is defined as: "a technique to replace or amplify real experiences with guided experiences that evoke or replicate substantial aspects of the real world in a fully interactive manner" (Gaba, 2004, p. i2). Therefore, a simulated learning environment (SLE) is a learning setting that replicates real-world practice within a controlled environment. (Dzulkarnain et al., 2015; Gaba, 2004). The concept of SLE, originating in initial training techniques employed in the military and aviation industries (Gaba et al., 2001).

Flight simulators have become an essential component of pilot training, offering lifelike practice sessions that eliminate the risks associated with real flights. As technology advanced, these principles were adopted in other fields such as medical education (Berman et al., 2016; Gaba et al., 2001; Gastelum et al., 2016), nursing (Forsberg et al., 2019; Georg & Zary, 2014; Jeffries et al., 2003) , audiology (Dzulkarnain et al., 2014, 2015) to name a few.

SLE serves as an alternative and addition to traditional clinical education such as lectures, clinical placement and case studies (Jeffries et al., 2003; Macbean et al., 2013). Clinard and Dudding (2019) listed five modes of SLE commonly used in healthcare training, (i) standardized patient - an individual replicates the behavior of a real patient in a consistent and reproducible manner, (ii) task trainer - a device used to enhance specific skills through training, (iii) manikins - a humanoid simulator designed to replicate human functions, (iv) computer-based simulations - a virtual training method that uses computer software to create interactive, realistic scenarios for the purpose of practicing and (v) immersive virtual reality - an immersive learning environment that utilizes computer technology to create a three-dimensional space.

The application of SLE has several advantages. SLE has been found to be a safe method to train students' clinical skills, as they do not see real patients. Therefore, it reduces stress among students and prepares them before the real clinical placement by supporting them to practice in a controlled environment (Clinard & Dudding,2019; Miles et al., 2016). It also allowed manipulation of clinical scenarios and enable assessment of students in identical situations (Alinier, 2007). Integrating SLE into the

speech-language therapy program has been shown to assist students in gaining access to a wider range of clients and bridging the gap between theoretical knowledge learnt in the classroom and clinical skills (Clinard & Dudding, 2019).

2.5.2 Simulated Learning Environment in Speech-language Therapy

MacBean and her colleagues (2013) conducted comprehensive research on the use of SLE among university speech-language therapy stakeholders in Australia. This study was carried out in four stages, including two surveys, a literature review of existing SLEs, and a national forum to discuss the current and future potential of SLE. The research identified standardized patients (SP) and virtual-based simulators, such as virtual patients (VP) and interactive computer-based packages, as the top two SLEs recommended for inclusion in speech-language pathology curricula (Macbean et al., 2013). The primary objective of integrating SLEs is to reduce the workload on clinical educators while expanding the capacity for clinical education, with SLEs proving to be more effective in achieving these goals than other methods (MacBean et al., 2013). Recently, Dudding and Nottingham (2018) confirmed that the two modes of SLE mentioned by Macbean and her colleagues (2013) are indeed mostly used in the speech-language therapy university training programs.

Several studies in the field of speech-language therapy clinical education have documented the use of SP for training students in various areas. These include consulting on therapy techniques for patients with voice disorders (Syder, 1996), managing patients with aphasia (Zraick, Allen & Jonhson, 2003), enhancing foundational interaction skills with patients (Hill et al., 2013), training on augmentative and alternative communications in telepractice (Howells et al., 2019) and training students in stuttering management (Penman et al., 2021). All of these studies have demonstrated favourable results in the domain of speech-language pathology training. Students have reported reduced anxiety and improved confidence in their related clinical skills (Hill et al., 2013; Howells et al., 2019; Penman et al., 2021). The use of SP, actors trained to interact with students, however, is no longer novel in the healthcare system. Barrows (1993) noted that SP had already been utilized for 30 years, particularly in tasks related to history taking. SP allows educators to structure situations or experience (MacBean et al., 2013) and allows hand-on without direct impact on

patients (Ward et al., 2015). However, it is costly (McIntosh et al., 2006) and involves training of actors that is making it time consuming (Wallace et al., 2002).

In the speech-language therapy training compared to SP, the research on computerized-based SLE is still limited (Carter, 2019; Okopal, 2019). One of the most popular computer-package simulation in the speech-language therapy is the SimuCase™(Carter, 2019; Dudding & Nottingham, 2018; Stead et al., 2022). Dudding and Nottingham (2018) attributed the widespread use of computer-based SLE during their research to the commercial availability of SimuCase™, which had been available for two years prior to their study. SimuCase™ is a digital package that allows learners to engage with the VP to make decisions regarding the procedures in speech-language pathology assessment and intervention (Jansen et al., 2015). SimuCase™ has two modes: "Learner Mode" and "Assessment Mode". Feedback is available in "Learner Mode" but not in "Assessment Mode"(Jansen et al., 2015). The SimuCase™ includes both adult and pediatric cases (Jansen et al., 2015).

Carter (2019) compared students' pre- and post-training performance on pediatric speech-language cases between a traditional training group and a simulation group. The traditional group was trained by solving hard-copy case studies, followed by grading and discussion, whereas the simulation group utilized SimuCase™ for training. While both groups showed improvement post-training, the simulation group demonstrated superior performance in various clinical skills, including asking questions, making diagnoses, and providing rehabilitation recommendations. Additionally, the simulation group showed enhanced critical thinking abilities. However, the significant improvement observed in the simulation-trained group could be influenced by the training method, as SimuCase™ involves more two-way communication and direct feedback compared to the traditional group, which received summative feedback only. Studies has shown that direct immediate feedback is superior in comparison to delayed feedback in enhancing learning outcomes and retention (Dihoff et al., 2004; Epstein et al., 2002). Nevertheless, Carter's (2019) study demonstrated the potential of computer-based simulated learning environments to enhance clinical training for speech-language therapy students. The usage of virtual-based computer simulation also has been proven to be easily accessible, highly standardized and cost-effective (Triola et al., 2006).

2.5.2.1 Simulated Learning Environments in Dysphagia Training

Several types of SLEs have been specifically implemented in dysphagia training for speech-language therapy students, aiming to enhance their readiness for clinical practice (Burns et al., 2021; Hill et al., 2021; Miles et al., 2016; Ward et al., 2015) and advance skill (Ward et al., 2014). These above-mentioned studies include SLE training using SP, task trainer, and the use of manikins. Training in dysphagia management that involves invasive procedures, pediatric populations, or critical care patients often requires the use of human patient simulation (Ward et al., 2015). Human patient simulation typically involved the use of task trainers or manikins to develop the necessary physical skills (Carter, 2019; Ward et al., 2015). Benadom and Potter (2011) were among the first to report on the training of transnasal endoscopic procedures, particularly as part of fiberoptic endoscopic evaluation for dysphagia management in the field of speech-language therapy using human patient simulator and non-lifelike simulator. The results revealed that the graduates' skills and confidence improved, enabling them to practice repeatedly without compromising patient care (Benadom & Potter, 2011). In addition, with the training using human-patient simulation, experienced graduates were tasked as supervisors, thereby reducing the workload on faculty during that period (Benadom & Potter, 2011).

On the other hand, Ward et al. (2015) conducted a study on the usage of human patient simulation in a dysphagia training for paediatric population. In this study, Ward and her colleagues covered the technical and non-technical skills in the management of paediatric dysphagia. The technical parts involve the manual handling of cases, while the non-technical abilities involve communication and engagement. In general, students demonstrated improvement in their level of confidence, clinical abilities, and preparedness when compared just to the academic program (Ward et al., 2015).

In another dysphagia training using SLE, Miles and colleagues (2016) incorporated part task, manikin and SP. The training was conducted among dietitian and speech-language therapy students in a two-half day course. In the training, students were trained to complete part task assignment in simulated ward environment and solved three clinical scenarios involving SP and the usage of manikin. Discussions were allowed during the clinical scenarios task. Data collected included pre and post survey of confidence, knowledge and hospital readiness. Other than that, participants were asked to complete written clinical vignettes to evaluate interprofessional competencies

one-month prior training, a day before training and post training. The findings of this study also shown a rise in confidence, preparation, dysphagia clinical knowledge, and clinical reasoning skills after undergoing SLE.

While the benefits of the SLE training mentioned above are clear, some challenges associated with using these modes of SLE are worth noting. Initially, the training involved the use of SP and manikins, which necessitated their physical presence in the same location. The SPs were expected to accurately depict the symptoms associated with the specified condition (Shankar, 2016; Wallace et al., 2002). In addition, these activities usually require thorough preparation and strategic planning to create educational materials and scripts/scenarios, as well as to arrange suitable locations and acquire acceptable actors prior to the students' participation (Dudding & Nottingham, 2018; Wallace et al., 2002). Conversely, manikins for SLEs are also recognized for their high cost (Clark & Lombard, 2020).

To overcome these challenges, computer-based SLE can be employed. Computer-based SLE enable students to perform activities remotely, without the need for students, actors, or instructors to be physically present in the same location. In addition, computer-based SLE can offer learners consistent exposure to standardized simulated patients and grant them access to a diverse range of diagnostic categories (Edelbring et al., 2011; Plackett et al., 2022). Although the initial construction of computer-based SLE requires significant effort, it is proved to be cost-effective in the long term (Triola et al., 2006).

2.5.2.2 Computer-based SLE in Dysphagia Training

Since the introduction of the VFSS in dysphagia management, Logemann et. al (1989) has provided visual training of dynamic swallow through educational videos in *Videofluoroscopic Swallowing Studies: Evaluation and Therapy Planning*. These videos are intended to show students the normal swallowing processes and some of the common rehabilitation techniques and compensatory strategies for dysphagia. As technology has become more advanced, Scholten and Russel (2000) developed new interactive software called *The Dynamic Swallow.* In this software, students are able to manipulate animations of swallowing, looking at cause and effect of anatomical or physiological changes in swallowing functions (Scholten & Russell, 2000). Another

advantage of this software is its ability to provide direct voice-over feedback. *The Dynamic Swallow* has proven to improve learning outcomes of speech-language therapy students with increased in time of exploring the software (Scholten, 2001b). Subsequently, several computer-based training programs have been developed using various approaches to address specific areas of clinical practice, such as the anatomy and physiology of normal swallowing (Chow et al., 2018), VFSS interpretation (Martin-Harris, 1999, 2000; Burns et al., 2021), and FEES interpretations (Brady et al., 2018). The computer packages created by these authors were in the form of courseware rather than SLE. Courseware is broader and more content-focused, often covering entire courses specific lessons within a curriculum, while SLE is more task-oriented, mimicking real-practice for skill development (Mayer, 2002).

To our knowledge, there are currently three dysphagia training programs conducted using computer-based SLE. The first training program was a virtual program created by Sia and colleague (2016). It specifically aimed to enhance the clinical interviewing and reasoning abilities of speech-language therapy students in the context of dysphagia management (Sia et al., 2016). This VP-based simulator allowed students to engage in interactive chat-based conversations tailored to a given patient's dysphagia profile. Students had the opportunity to develop history-taking scripts by completing pre-populated questions and conducting additional interviews with the VP. The application of the VP-based simulator yielded positive outcomes, with speech-language therapy students demonstrating an ability to identify more precise supporting reasons for making diagnoses and showing greater empathy towards the 'patients'. This study highlighted the educational benefits of incorporating VP-based simulation training in dysphagia management for undergraduates.

The second study that employed computer-based SLE in dysphagia is the study by Ferguson and Estis (2018), which utilized video-recorded high-fidelity manikins to evaluate the proficiency of graduate students in assessing feeding skills in simulated preterm infants. In this study, 108 nursing and speech-language therapy students were divided into two groups: one group received didactic training, while the other group received didactic training together with simulation videos. The subjects covered were infant behavioral disorganization, physiological distress indicators during oral feeding, and essential elements for evaluating infants' feeding behavior. The didactic training was delivered over five to seven days in an online format using voice-over PowerPoint presentations. The additional simulation videos for the didactic training with the

simulation videos group consisted of eight pre-recorded videos depicting infant feeding scenarios using manikins. The results indicated that general knowledge improved irrespective of the training approach. However, students who received additional training through simulated videos demonstrated a greater capacity to identify simulated feeding patterns and record symptoms of distress. Hence, the utilization of online video simulation with video-recorded manikins has demonstrated its effectiveness in enhancing the proficiency in clinical swallowing and feeding assessment of preterm infants in this particular group.

The third study that utilized computer-based SLE was by Bryan (2022). Bryan (2022) introduced training on bedside swallowing evaluation and VFSS analysis using a newly developed computer-based SLE that includes video recordings of SP and VFSS videos. In the study, 27 speech-language pathology students who had already completed their dysphagia course were asked to complete two dysphagia scenarios using the computerized SLE. They interpreted the cranial nerve functions based on the simulated patient videos, interpreted the outcomes from VFSS videos, provided overall impressions, and made treatment recommendations. Students were also asked to record videos of themselves giving instructions to the SP. Simulation studies 1 and 2 were conducted at a one-week interval, and feedback was provided after each simulation. Surveys measuring self-efficacy were gathered before the training, after the first simulation study, and after the second simulation study. In general, students demonstrated an enhancement in self-efficacy from the initial assessment to the second simulation research. They also showed improvement in assessing cranial nerves and making recommendations, comparing simulation 1 to simulation 2. Nevertheless, no notable improvements were observed in the proficiency of VFSS interpretation. It is important to note that achieving high inter-rater reliability in VFSS interpretation is typically challenging even in clinical setting and may require more intensive training (Bryan, 2022; Slovarp et al., 2018).

Based on the literature review, research on SLEs in speech-language therapy remains limited (Hewat et al., 2020; Macbean et al., 2013). While the discussed studies have demonstrated successful outcomes in teaching specific skills, further research is warranted in other areas of dysphagia study. Challenges also arise in implementing the readily available manikins or computer packages in the Malaysian setting. For instance, the current commercially available computer packages for training and manikins are from overseas, and considering the exchange rate, they would be too expensive for local

universities to purchase or subscribe to. Therefore, the development of an interactive, self-training system for dysphagia management that is specifically tailored to the Malaysian speech-language therapy context and clinical practice could be highly beneficial.

2.6 RESEARCH THEORY AND FRAMEWORK

2.6.1 Experiential Learning Theory

The underpinning theory of the current research is the Experiential Learning Theory (ELT; Kolb, 1984). ELT is founded on the concept that learning is an active process in which learners create new knowledge and experiences by building upon their existing understanding and knowledge, which can be accomplished with SLE (Maran & Glavin, 2003). SLE training promote experiential learning and reflective thinking (Forsberg et al., 2019; Motola et al., 2013).The method of acquiring knowledge based on ELT consists of a four-stage cycle (see Figure 2.1).

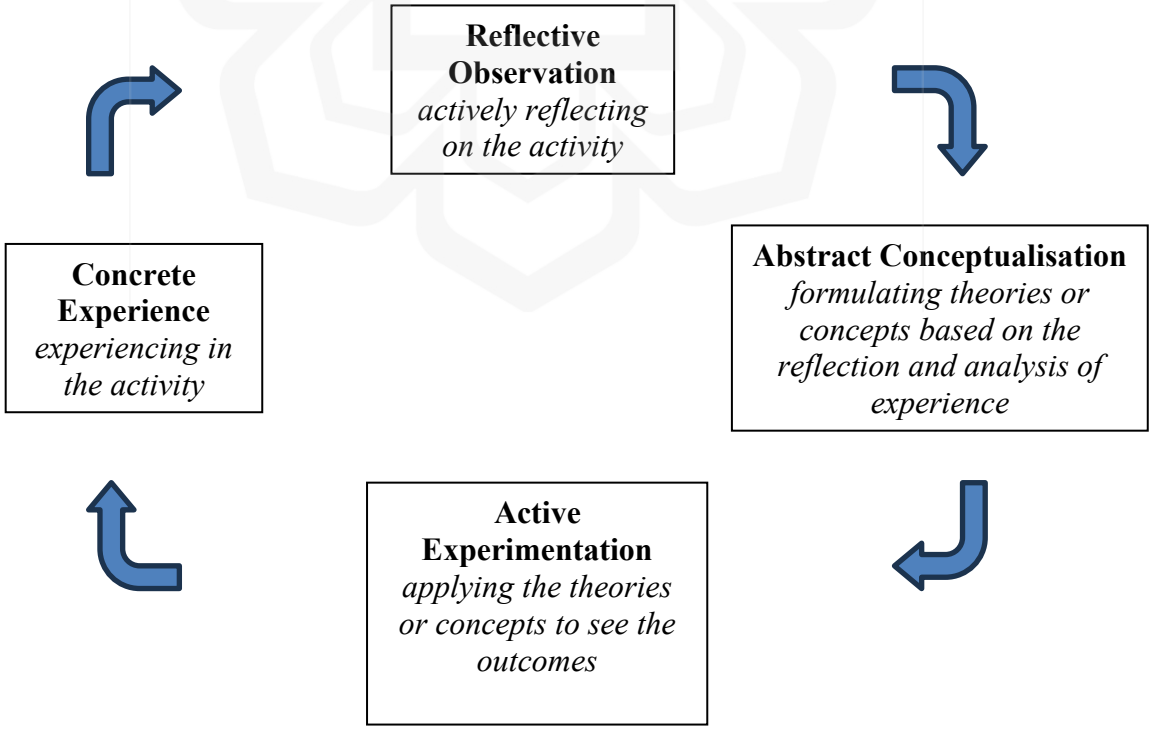


Figure 2.1 The Experiential Theory by Kolb (1984)

The four stages of the circle are concrete experience, reflective observation, abstract conceptualisation and active experimentation. The four stages cycle illustrating how experience is transformed through reflection into concepts that can guide active experimentation and the selection of new experiences. The cycle can be initiated at any stage; however, the steps must be followed in a specific order (Akella, 2010). Learners progress through the cycle multiple times, resulting in the overall process being characterized as a spiral of cycles. The brief description of Kolb's (1984) ELT stages are as follows:

(i) **Concrete experience**: provides the basis for the learning process. The learner acquires knowledge and skills by being adaptable and actively engaging with the situation.

(ii) **Reflective observation**: learner analyzing the reasons and processes behind their experiences. The learner engages in reflection, observation, and critical examination of their experiences.

(iii) **Abstract conceptualization**: learner formulate theories or concepts based on the reflection and analysis of the experience.

(iv) **Active experimentation**: learner applying the new concepts and theories to see the outcomes.

In an actual clinical environment, learners acquire experiential learning through direct interaction with patients. Thus, users possess the ability to make connections between their past experiences and their present case encounters in an actual setting, allowing for reflection (Scholten, 2001a; Schon, 1983). Using SLE, episodes of experiences are purposefully generated. Often, SLEs are built based on case-based learning principles (CBL; Carter, 2019). CBL involves students in discussions about clinical scenarios, helping them identify client issues, compare and evaluate potential solutions, and decide how to handle clinical situations (McCabe et al., 2009). By deliberately manipulating patient scenarios during training, users can engage in reflection-in-action (Maran & Glavin, 2003; Schön, 1983). Through the application of CBL, students' learning is improved by the interaction between their existing knowledge and current circumstances (McCabe et al., 2009).

2.6.2 Conceptual Framework

Consistent with the ELT framework of action and reflection, the ISD cases offer students the opportunity to engage in a SLE and facilitate the gathering of information and making clinical decisions in a safe environment. Prior to the ISD training, the speech-language therapy students had already completed a semester-long dysphagia course at the university. Therefore, their pre-existing knowledge from long-term memory integrates within the four stages of ELT during ISD utilization.

First, when the students began a case in the ISD, they planned and engaged in a new **concrete experience**, developing a structured approach to problem-solving that provided them with a comprehensive understanding of the patients' conditions. In the **Reflective Observation** stage, engaging in an ISD situation stimulated the students' intellectual curiosity, prompting them to critically analyze and seek additional knowledge.

In the **Abstract Conceptualization** stage, the students' capacity to convert theoretical knowledge into clinical thinking was emphasized. By integrating theory and practice, and subsequently using theoretical knowledge in practical situations, the students enhanced their clinical thinking. They developed a deeper understanding of dysphagia management principles through the reflection and feedback process.

In the final stage of **Active Experimentation**, the students assessed their own understanding in subsequent ISD scenarios. The feedback provided in the ISD enhanced their self-awareness of their skills.

Through participation in the ISD training, it is expected that the students will show improvement in their clinical knowledge and skill. Figure 2.2 shows the conceptual framework of this research.

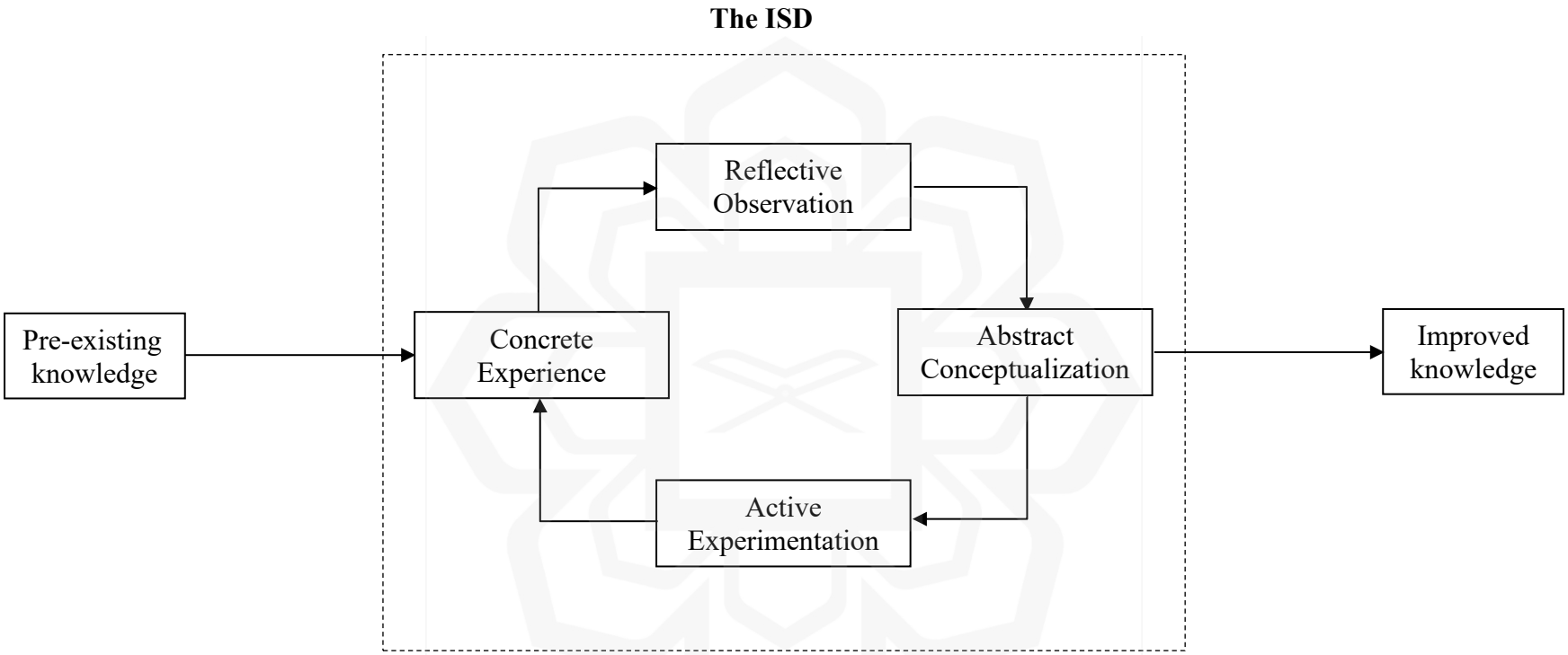


Figure 2.2 Conceptual framework of the study

CHAPTER THREE

PROBLEM STATEMENT, STUDY OBJECTIVES, HYPOTHESIS AND RESEARCH PHASES

3.1 INTRODUCTION

This chapter outlines the problem statement derived from the limitations identified in the prior literature review, which thereby highlights the need for the development of new interactive self-training system (ISD). This chapter continues with the description of the research objectives and the hypotheses of the study. Additionally, a general overview of the study approach is provided. A thorough description for the methodology of each phase, including the participant recruitment, research procedures, data analysis, and discussion will be explained in detail in Chapter 4 to 6.

3.2 PROBLEM STATEMENT

Effective management of dysphagia is a crucial duty of SLTs (ASHA, 2015; 2016; RCSLT, 2005; Speech Pathology Australia, 2011). However, the proficiency and confidence of SLTs in this area are still suboptimal especially for new SLTs (Caesar & Kitila, 2020; Singh et al., 2015; Urban & Hazelwood, 2019). As discussed in Section 2.4.5, previous studies have highlighted significant challenges in dysphagia training across countries, including a shortage of clinical educators, limited clinical placement opportunities, reduced exposure to dysphagia cases, and constraints in resources such as funding and access to instrumental assessments (Hill et al., 2010; McAllister, 2005; Mustaffa Kamal et al., 2015; Rodger et al., 2008; Singh et al., 2015; Ward et al., 2015). These challenges, coupled with the growing student population, have prompted the search for supplementary training approaches. SLE have been recognized as a viable option, offering consistent, standardized training, particularly during the COVID-19 pandemic when in-person training was restricted (Alinier & Oriot, 2022; Gaba, 2004; Nagdee et al., 2022). Although in Malaysia the speech-language therapy curriculum has

evolved to include practical training alongside theory, simulations are still viewed as valuable supplementary tools because of their ability to prepare students before clinical placements and potentially enhance their confidence. Despite this, computerized SLE for dysphagia remain limited, and none focus on the Malaysian context, where CSE and FEES interpretations are frequently utilized (Mustaffa Kamal et al., 2012a). Therefore, the ISD was developed as an interactive self-training system to train Malaysian SLT students in these essential skills.

3.3 RESEARCH OBJECTIVES

The present work aimed to achieve the following objectives:

3.3.1 General Objective:

This research was designed to develop and validate a new interactive self-training system for dysphagia management (the ISD) for speech-language therapy students.

3.3.2 Specific Objectives (SO):

SO1 : To develop and validate a survey that can be used to assess clinical educators' perceptions regarding students' clinical incompetencies during dysphagia training and the challenges experienced during the training.

SO2 : To explore clinical educators' opinion on students' clinical incompetencies during dysphagia training and challenges faced during the training.

SO3 : To explore clinical educators' opinion on virtual learning dysphagia training.

SO4 : To develop and validate the ISD.

SO5 : To investigate the effect of the ISD compared to classroom-based training on student's application-based knowledge of dysphagia management.

SO6 : To examine the usability of the ISD.

3.4 RESEARCH HYPOTHESES

Based on SO5 and SO6, four hypotheses were developed.

H_{A1} : There is no significant difference in the mean score of the pre-test between ISD training and classroom-based training group.

H_{A2} : There is no significant difference in the mean score of the post-test between ISD training and classroom-based training group.

H_{A3} : There is no significant difference in the normalized gain score between ISD training and classroom-based training group.

H_{A4} : There is no significant difference in Instructional Material Motivation Survey scores between ISD training and classroom-based training group.

3.5 ETHICAL CLEARANCE

Prior to the commencement of the study, an ethical clearance was sought from the Kulliyyah of Allied Health Sciences (KAHS) research committee. After the approval was gained from the Kulliyyah, an online ethical application was submitted to the International Islamic University Malaysia (IIUM) Research Ethics Committee (IREC). Following approval from the IREC committee, permission to conduct study at SASMEC was also obtained from SASMEC Research Committee (SASRC) to allow access to i-Pesakit and data collection from the Department of Ear, Nose and Throat (ENT). The letter for the ethical clearance can be found at appendix A (reference number: IREC 2019-151).

3.6 RESEARCH PHASES

To achieve the research objective of developing and validating the ISD, the study was guided by the ADDIE model, which is one of the instructional design methods (Peterson, 2003). The acronym ADDIE represents the distinct phases in the model, namely analysis (A), design (D), development (D), implementation (I), and evaluation (E) (Peterson, 2003). The selection of this model was based on its extensive usage in the development of modules and training programs including in education and health

science (Alnajdi, 2018; Yee et al., 2018). The distinct phases in the ADDIE model align closely with the standards of best practice suggested by Lioce et al. (2015) for simulation design, making it a suitable model for developing the ISD. Furthermore, the implementation of this model during the development process can ensure the quality of the program by providing a systematic and well-defined framework for each stage of development (Peterson, 2003). By following these phases, the ISD can be systematically designed to address specific educational needs. The general descriptions of each phase are as follows:

i) **Analysis**

The analysis phase is the initial and foundation for all other phases. The outcomes of the needs analysis provide guidance to the designer in formulating a comprehensive aim or broad purpose for the program (Lioce et al., 2015; Peterson, 2003). Through needs analysis, the specific needs of the intended audience are identified by assessing students' existing knowledge and determine areas where they need to acquire new knowledge (Peterson, 2003). In this study, a needs analysis was conducted to understand the gaps in dysphagia training for speech-language therapy students, particularly within the Malaysian context. This analysis focused on identifying clinical incompetencies among students and the specific challenges encountered during the delivery of dysphagia management training. The identification of incompetencies among students in this study serves to justify the selection of subtopics and feedback incorporated into the ISD, ensuring that the training content directly addresses the specific gaps observed in students' dysphagia management performance. A comprehensive description of the analysis conducted through survey development and distribution, along with its findings, is provided in Chapter 4.

ii) **Design**

In this phase, the focus was to determine the objectives, ascertain the means to achieve these objectives, selecting the instructional strategies to be employed, and selecting the suitable medium or methods to effectively deliver the objectives (Lioce et al., 2015; Peterson, 2003). Additionally,

suitable assessment methods that align with the objectives were determined (Peterson, 2003). Considering the findings from analysis, the structure and content of the ISD were outlined during this phase, encompassing the learning objectives, instructional strategies, modality and interactive elements, as well as the assessment methods.

iii) **Development**

Building upon the previous two stages, this phase is characterized by the development of the product and materials (Peterson, 2003; Yee et al., 2018). This process includes creating digital content such as images, videos, and the interface, which form the core of the ISD. To ensure the quality and validity of the intellectual content, evaluations were also conducted on the product during this phase (Lioce et al., 2015; Peterson, 2003). Content experts, specifically clinical educators, were invited to validate the content and materials of the ISD.

iv) **Implementation**

During the implementation phase, the program underwent testing by instructors or the target audience to facilitate ongoing adjustments to guarantee its efficiency (Peterson, 2003; Yee et al., 2018). The ISD was tested by SLTs for its functionality at this phase. Comprehensive details regarding the design, development, and implementation stages of the ISD are presented in Chapter 5.

v) **Evaluation**

The final phase in the ADDIE model is the evaluation phase. Evaluations were carried out to evaluate the accomplishment of the program's objective and the impact of the program for changes in the future delivery (Peterson, 2003). Therefore, the ISD was evaluated with undergraduates' speech-language therapy students for its effectiveness and identify areas for improvement. The evaluations of the ISD are presented in Chapter 6.

Figure 3.1 presents a flowchart summarizing the overall procedures used in this study, based on the phases described above. As depicted in the figure, the first three

specific objectives were addressed during the analysis phase, while another objective was tackled during the design, development, and implementation phases. The final two objectives were covered in the evaluation phase.

PHASE	SPECIFIC OBJECTIVES	PROCEDURE
I Analysis	1. To develop and validate a survey that can be used to assess clinical educators' perceptions regarding students' clinical incompetencies during dysphagia training and the challenges experienced during the training. 2. To explore clinical educators' opinion on students' clinical incompetencies during dysphagia training and challenges faced during the training. 4. To explore clinical educators' opinion on virtual learning dysphagia training.	Survey development and administration
II Design, Development and Implementation	5. To develop and validate the ISD.	Development of the ISD (i.e., scripts, storyboard and the ISD prototype)
III Evaluation	4. To investigate the effect of the ISD training compared to classroom-based training on student's application-based knowledge of dysphagia management. 5. To examine the usability of the ISD.	Evaluation of the ISD by comparing pre and post-test scores with different training methods (i.e., classroom-based learning)

Figure 3.1 Research phases and flowchart of procedures

CHAPTER FOUR

PHASE I (ANALYSIS): IDENTIFICATION OF COMMON CLINICAL INCOMPETENCIES AMONG SLT STUDENTS DURING DYSPHAGIA TRAINING AND SURVEY ON SIMULATED LEARNING ENVIRONMENT (SLE) AMONG CLINICAL EDUCATORS

4.1 INTRODUCTION

In Chapter 2, the exploration of literature reviews highlighted that various simulation-based training methods have consistently produced positive outcomes for both students and SLTs (Hill et al., 2013; Penman et al., 2021; Zraick et al., 2003). While some SLEs emphasize hands-on training for dysphagia and feeding management (Benadom & Potter, 2011; Miles et al., 2016; Ward et al., 2015), the existing literature on computer-based SLEs for dysphagia primarily centers around clinical interviewing skills, feeding techniques, and VFSS interpretation (Bryan, 2022; Ferguson & Estis, 2018; Sia et al., 2016). Since earlier studies focused on different objectives, conducting a needs analysis was essential to address the specific demands of dysphagia training in Malaysia.

According to the first step in the ADDIE model, which is analysis, this phase involves identifying instructional problems and learning objectives (Davis, 2013). Needs analysis is also recommended as the initial phase of simulation design, during which designers gather information to create objectives tailored specifically to the simulation participants (Lioce et al., 2015). Consequently, the development of the ISD began with an online survey aimed at identifying the clinical incompetencies commonly made by speech-language therapy students during dysphagia training, as well as the challenges faced in delivering dysphagia training within the Malaysian context, specifically in FEES. In this study, the identification of clinical incompetencies serves as a foundation for understanding specific areas where theory-to-practice translation breaks down, thereby guiding the development of more effective training interventions.

Other than that, the needs analysis in Phase I was conducted to explore Malaysian clinical educators' knowledge and perceptions regarding SLE. This holistic understanding serves to tailor the ISD to meet their expectations and align with their existing knowledge base, which is essential for ensuring its effectiveness and relevance.

4.2 METHODOLOGY

4.2.1 Survey Development

Lioce et al. (2015) suggests that conducting a survey targeting educators, stakeholders, and participants is an effective method for gaining insights into skills and knowledge. Therefore, to gather valuable perspectives from clinical educators on common clinical incompetencies among speech-language therapy students and the challenges during dysphagia management training, an exploratory study was undertaken, utilizing a specially developed survey question. The development of the survey was divided into four stages and is summarized in Figure 4.1.

The developed survey was distributed to the expert's panel via online method (Google form) and offline (printed form). The printed forms were either posted or passed and collected according to the expert's panel request and conveniences. The initial copy of the survey is attached in Appendix B.

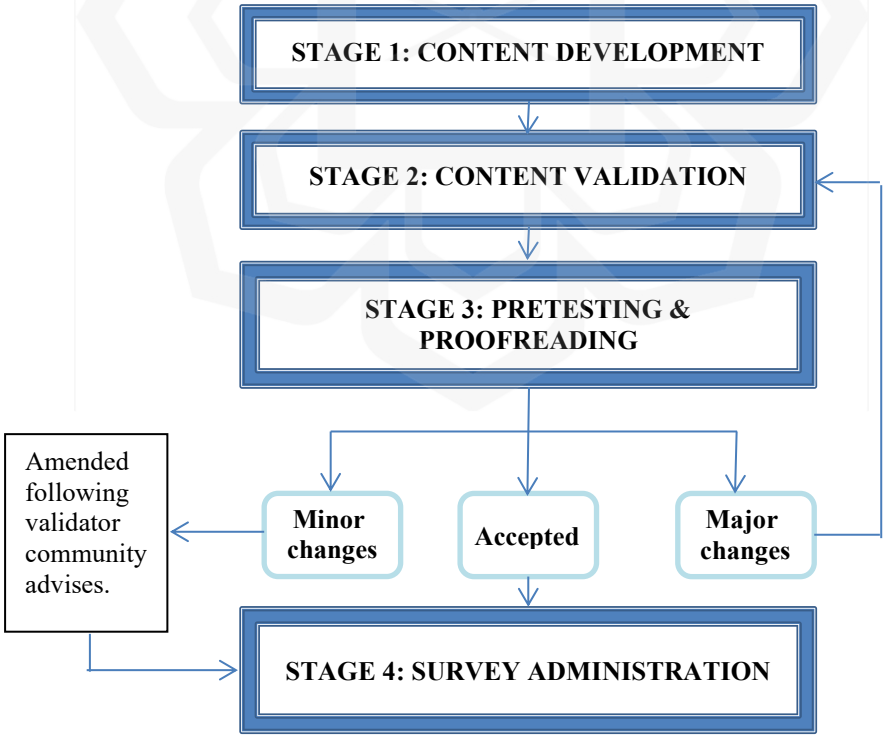


Figure 4.1 Workflow for survey development and administration

4.2.1.1 Survey Content Development

The survey was divided into four sections: (A) demographic information, (B) identification of clinical incompetencies among speech-language therapy students, (C) perception on speech-language therapy students' challenge during dysphagia clinical training and (D) opinion on teaching using SLE method. The demographic information section included questions on age, educational background, work experience, supervisory experience, and the number of hours spent teaching FEES.

The first step of the survey development is to identify the categories and items to be included in the survey. The identification of the categories and items in Section B was based on the IIUM Speech-Language Pathology Clinical Guideline, the IIUM Speech-Language Pathology Clinic Outline, and the Ministry of Health (2023) standard operating procedure (SOP) for dysphagia patients which was accessible through the MoH website. The items for identifying potential clinical incompetencies made by students (Section B), were also carefully formulated based on a review of learning outcomes mapped in a simulation-based study for speech-language therapy (Hewat et al., 2020) and a questionnaire on audiology students' clinical errors (Kamal Bahri, 2018). Forty items that consist of the possible clinical incompetencies by speech-language therapy student during dysphagia management were derived and grouped under eight categories: (1) case history, (2) oral motor examination (OME), (3) cervical auscultation (CA) and hyolaryngeal excursion (HE), (4) water and food test, (5) FEES, (6) management and plan, (7) case note and (8) professionalism. For this study, three domains were adapted to categorize the items, drawing from the generic competency domains and characteristics outlined in the Speech Pathology Australia's standardized competency assessment for speech therapy (COMPASS®)(Mcallister et al., 2013). These domains include reasoning, communication, and professionalism, with clinical skill domains broadly referenced. The reasoning domain emphasizes students' cognitive capacity to synthesize knowledge and adopt a holistic viewpoint when making professional decisions and plans (Mcallister et al., 2013). On the other hand, the communication domain refers to students' ability to utilize interpersonal communication skills to enhance the efficacy of speech therapy practice (Mcallister et al., 2013) and the professional domain focuses on students' demonstration of proficient organizational abilities, professional manner, and ethical conduct (Mcallister et al., 2013). Finally, the clinical skill domain pertains to the student's capacity to examine,

evaluate, and incorporate scientific evidence-based practice in relation to a patient's condition (Kamal Bahri, 2018). The summary of the categories included in Section B and the sources are summarized in Table 4.1.

Table 4.1 The Sources for each item on Section B (Initial Version)

CATEGORY/ITEMS		DOMAIN	SOURCES**
CASE HISTORY			
1.	Unable to conduct a comprehensive history taking.	Clinical skill	G, O, B
2.	Unable to use simple and clear questions.	Communication	H, B
3.	Using jargons and medical terms with the patient.	Communication	H, B
4.	Unable to rephrase questions when patient find it difficult to understand.	Communication	H, B
5.	Unable to probe for details and further data/ facts from patient's given information.	Clinical skill	K, H, B
ORAL MOTOR EXAMINATION			
1.	Demonstrate wrong technique when examining the patient.	Clinical skill	G, O, K, H, B
2.	Unable to provide correct/proper instructions to the patient.	Communication	G, O, K, H, B
3.	Unable to relate the findings with cranial nerve functions.	Reasoning	G, O, K, H, B
4.	Incorrect placement of utensil (eg tongue depressor).	Clinical skill	G, O, K, H, B
5.	Unable to relate the findings to determine type of instrumental assessment to be conducted.	Reasoning	G, O, K, H, B
CERVICAL AUSCULTATION			

1.	Unable to palpate the correct structures.	Clinical skill	G, K
2.	Unable to differentiate normal or abnormal hyolaryngeal excursion.	Reasoning	G, K
3.	Incorrect placement of the stethoscope	Clinical skill	G, K
4.	Unable to listen to swallow sounds using stethoscope.	Clinical skill	G, K
WATER AND FOOD TEST			
1.	Unable to decide which consistency to be tested with the patient.	Reasoning	G, O, K, H
2.	Unable to handle patient with sufficient care to ensure safety.	Clinical skill	G, O, K, H, B
3.	Unable to differentiate types of food/drink consistencies.	Clinical skill	G, O, K, H
4.	Unable to prepare the exact drink/food consistencies using food thickener.	Clinical skill	G, O, K, H
5.	Unable to decide if patient passed or failed the test.	Reasoning	G, O, K, H
FIBERENDOSCOPIC EXAMINATION OF SWALLOWING (FEES)			
1.	Unable to provide correct/proper instructions to the patient.	Communication	G, O, K, H
2.	Unable to relate the findings with cranial nerve functions.	Reasoning	G, O, K, H
3.	Unable to identify the correct anatomical structures.	Clinical skill	G, O, K, H
4.	Unable to interpret the findings from the observation.	Reasoning	G, O, K, H
MANAGEMENT AND PLAN			
1.	Unable to integrate the results of all the assessment conducted.	Reasoning	G, O, K, H, B

2.	Unable to interpret the findings to determine a correct diagnosis.	Reasoning	G, O, K, H, B
3.	Unable to use the findings to determine a proper plan for the patient.	Reasoning	G, O, K, H, B
4.	Unable to explain the result to the patient.	Clinical skill	G, O, K, H, B
5.	Unable to use layman terms when explaining results to the patient.	Communication	G, O, K, H, B
6.	Unable to recommend referrals to other professionals.	Clinical skill	G, O, K, H, B
CASE NOTE			
1.	Unable to come with correct impression or differential diagnosis.	Clinical skill	G, O, K, H, B
2.	Unable to write clear and correct notes.	Clinical skill	G, O, K, H, B
3.	Unable to write clear, correct and comprehensive notes.	Clinical skill	G, O, K, H, B
PROFESSIONALISM			
1.	Patient was not greeted when entering the room.	Professionalism	O, B
2.	Unable to maintain good manner with the patient.	Professionalism	O, H, B
3.	Unable to conduct assessment in appropriate sequences.	Clinical skill	G, O, K, H, B
4.	Unable to maintain hygiene when dealing with patient.	Professionalism	O, K, B
5.	Unable to provide consultation using layman terms.	Communication	G, O, K, H, B
6.	Unable to maintain a comfortable distance from patient.	Professionalism	O, K, B
7.	Unable to appear confident during assessment and result delivery.	Professionalism	O, K, H, B

8.	Taking inappropriate time (e.g., too much time or too fast) during assessment.	Clinical skill	O, H, B

***Note*: G - IIUM Speech-Language Pathology Clinical Guideline, O - IIUM Speech-Language Pathology Clinic Outline, K – MoH SOP, H – Hewat et al. (2020), B – Kamal Bahri (2018)

In Section B, forty-four questions under nine categories were presented on a 4-point Likert scale based on the occurrence from (1) not at all , (2) rarely, (3) occasionally and to (4) frequently. This 4-point Likert scale is suitable on responses to measure attitudes, behavior and knowledge (Blair, Czaja& Blair, 2014). The items for the other sections of the survey (i.e., Section C and Section D) were developed based on a review of previous works by Dzulkarnain et al. (2015), Mustaffa Kamal, Ward, and Cornwell (2012), MacBean, Theodoros, and Davidson (2013), and McAllister and Lincoln (2004). Sections C and D included a mixture of multiple choice and open-ended questions. Open-ended questions were employed in opinion surveys to elicit more precise information compared to closed-ended questions (Groves et al., 2011). There were twelve questions in Section C and Section D in total.

4.2.1.2 Survey Content Validation

Upon completion of the content development, a content validation of the survey was conducted quantitatively and qualitatively. Content validation refers to the degree to which the survey items accurately represent the desired construct (Groves et al., 2011). Ensuring content validity is of utmost importance throughout the construction of the new scale, as it serves as a necessary first step for subsequent validity assessment (Zamanzadeh et al., 2015). The assessment of content validity requires a group of experts evaluating each item according to its relevance and representativeness to the content topic (Almanasreh et al., 2019; Polit et al., 2007). For this purpose, three clinical educators with experience in dysphagia management, along with one linguist, were recruited as the expert panel. The inclusion criteria of the clinical educators were:

1. Experienced SLT with more than five years of practice.

2. SLTs who had completed specialized dysphagia training (e.g., certified courses or postgraduate-level training) or who have consistently managed dysphagia cases in clinical practice for a minimum of five years.
3. Practicing as an SLT in a hospital or university setting.
4. Experienced in and actively engaged in supervising speech-language therapy students in dysphagia cases.

4.2.1.2.1 Qualitative Content Validity Analysis

The qualitative assessment of content validity was conducted by obtaining recommendations from experts in the field regarding the wording, grammar, sentence structure, and scoring (Yibrah, 2017). These comments were then used to make necessary adjustments to the survey. Additionally, supplementary columns were included at the end of each category to allow the panel experts to suggest any significant aspects that might have been missed in the survey.

Overall, some minor changes were made based on the expert panel's suggestions and comments, which were 1) changed of word selections; 2) correction of grammatical error; 3) improvement of sentence structure; 4) split of statements to improve clarity and 5) addition of information. Table 4.2 shows the items that were amended following expert committee review. Besides, a few questions were also added on certain categories. A few items from Section C were separated and placed in Section D, as they related to the topic on SLE. After the changes and amendments were made to the 52 initial items, the improved version of the survey was obtained (please refer to Appendix C).

Table 4.2 Qualitative content analysis for the survey 'Identification of Common Clinical Incompetencies among Speech-Language Therapy Students during Dysphagia Training and Survey on Simulated Learning Environment (SLE) among Clinical Educators'.

Section/Item No.	**Initial Version**	**Improved Version**	**Remarks**
Section B (Case History) Item 2	Unable to **use** simple and clear questions.	Unable to **give** simple and clear questions.	Changed of word selection.
Section B (Case History) Item 3	Using jargons and medical terms with the patient.	Using jargon and medical terms with the patient **and/or caregivers.**	Added information.
Section B (Case History) Item 4	Unable to rephrase questions when patients and/or caregivers **finds** it difficult to understand.	Unable to rephrase questions when patients and/or caregivers **find** it difficult to understand.	Grammatical error.
Section B (Oral Motor Examination) Item 2	Unable to **provide** correct/appropriate instructions to the patient.	Unable to **give** correct/appropriate instructions to the patient.	Changed of word selection.
Section B (Cervical Auscultation and Hyolaryngeal Excursion)	Title: **Cervical Auscultation**	Title**: Cervical Auscultation and Hyolaryngeal Excursion**	Added information.
Section B (Water and Food Test) Item 1	Unable to decide which consistency to be **tested** with the patient.	Unable to decide which consistency to be **prioritized when testing** the patient.	Improvement of sentence structure.

Section B (Water and Food Test) Item 5	Unable to decide if a patient passed or failed the test.	Unable to decide if a patient passed or failed the test **in relation to OME findings.**	Added information.
Section B (Water and Food Test) Item 6	-	Unable to decide indication for instrumental assessment.	Statement was added for this category.
Section B (Fiberendoscopic Examination of Swallowing) Item 1	Unable to **provide** correct/appropriate instructions to the patient.	Unable to **give** correct/appropriate instructions to the patient.	Changed of word selection.
Section B (Fiberendoscopic Examination of Swallowing) Item 5	-	Unable to give feedback to patient and/or caregivers.	Statement was added for this category.
Section B (Case Note) Item 2	Unable to write **clear and** correct notes.	Unable to write correct notes.	Statement was split to improve clarity.
Section B (Case Note) Item 3	Unable to write **clear and comprehensive** notes.	Unable to write clear notes.	Statement was split to improve clarity.
Section B (Case Note) Item 3	Unable to write **clear and comprehensive** notes.	Unable to write comprehensive notes.	Statement was split to improve clarity.
Section B (Professionalism) Item 2	Unable to maintain good **manner** with the patient.	Unable to maintain good **manners** with the patient.	Grammatical error.

Section C Item 1	What are the challenges faced by your students during dysphagia training?	List the challenges faced by your students during dysphagia training.	Changed of sentence structure.
Section D Item 1	-	Has your method of teaching changed over the years?	Question was added for this category.
Section D Item 2	How does the method of your teaching change over the years, if any?	If (1) Yes, how does the method of your teaching change?	Changed of sentence structure.

4.2.1.2.2 Quantitative Content Validity Analysis

For quantitative content validity analysis, Content Validity Index (CVI) was determined. Two scales, i.e. the Item-level CVI (I-CVI) and the overall scale CVI (S-CVI) were computed (Waltz and Bausell, 1981). The I-CVI measures the agreement proportion about the relevance of each item in the scale (Lynn, 1986). The experts were asked to rate the items in Section B relevancy based on a 4-point scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant) as proposed by Davis (1992). The I-CVI was calculated by dividing the number of experts who rated each item as 3 or 4 for relevancy by the total number of content experts. An item would be deemed suitable if its I-CVI value is above 79% (or 0.79) (Abdollahpour et al., 2010).

Using the I-CVI findings, calculations were performed for both the S-CVI/UA and S-CVI/Ave. The S-CVI/UA (Scale-Content Validity Index/Universal Agreement) represents the proportion of items rated as either 3 or 4 by all content experts, reflecting universal agreement. On the other hand, the S-CVI/Ave (Scale-Content Validity Index/Average) measures the average proportion of agreement across all items, calculated by averaging the I-CVI scores across the entire scale (Beck & Gable, 2001; Waltz & Bausell, 1981). Polit and Beck (2006) stated that a scale-level S-CVI/Ave of 0.90 or higher is considered sufficient for content validity. The overall I-CVI calculation for 44 items obtained a score of 1.0 which indicates a good result. This is because the

experts gave 3 and 4 points only for all items which indicate the statements are clear and appropriate. Thus, no items were eliminated during quantitative validity analysis. The summary of the obtained result is shown in Table 4.3.

Table 4.3 I-CVI and S-CVI for Section B items

Category/Item No.	**Expert 1**	**Expert 2**	**Expert 3**	**Experts in agreement**	**I-CVI**
CASE HISTORY					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
ORAL MOTOR EXAMINATION					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
CERVICAL AUSCULTATION AND HYOLARYNGEAL EXCURSION					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
WATER AND FOOD TEST					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
6.	√	√	√	3	1.000
FIBERENDOSCOPIC EXAMINATION OF SWALLOWING (FEES)					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000

4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
MANAGEMENT AND PLAN					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
6.	√	√	√	3	1.000
CASE NOTE					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
PROFESSIONALISM					
1.	√	√	√	3	1.000
2.	√	√	√	3	1.000
3.	√	√	√	3	1.000
4.	√	√	√	3	1.000
5.	√	√	√	3	1.000
6.	√	√	√	3	1.000
7.	√	√	√	3	1.000
8.	√	√	√	3	1.000
				Average I-CVI	1.000
Proportion relevant	1.00	1.00	1.00		

√ = rating 3 or 4

4.2.1.3 Pretesting of the Survey

The subsequent phase of the procedure involved pre-testing, which sought to confirm the comprehensibility and applicability of the items for the target population or a population similar to the target population (Borsa et al., 2012). Another three clinical educators were invited to complete the hard copy of the survey questions. The survey took approximately 10 to 15 minutes to complete. The analysis of the items was based on the qualitative aspects of their responses. According to Groves et al. (2011), survey designers can assess pre-testing responses by evaluating the percentage of inconsistent responses, the percentage of responses that directly aligned with the wording of the question, and the percentage of instances where respondents sought clarification on specific aspects of the questions. Following this approach, the responses provided by the three clinical educators were analyzed and demonstrated consistency, with all responses matching the intended questions. None of the clinical educators requested further clarification on any aspect of the questions. Therefore, all responses were deemed 100% appropriate for the survey, and no items required further revision.

4.3 SURVEY ADMINISTRATION

4.3.1 Respondent

The inclusion criteria for the SLTs mirrored those set for the expert validators. The criteria required that the SLTs should: 1) be experienced professionals with more than five years of practice in the field 2) have undergone specialized dysphagia training (e.g., certified courses or postgraduate-level training) or have been treating dysphagia patients for the past five years 3) be practicing as an SLT in either a hospital or university setting and 4) experienced in and actively engaged in supervising speech-language therapy students in dysphagia cases. It was estimated that a total of 42 SLTs were involved in supervising students during dysphagia training (personal communication with universities and KKM representatives, September 2020). According to the sample size calculation table by Krejcie and Morgan (1970), the targeted sample size was 37. The number of respondents obtained during survey administration was 11. Therefore, the

response rate for this survey is 29%. This percentage is deemed to be fair for survey with small sample size (Fosnacht et al., 2017). The summary of the 11 respondent's demographic information is presented in Table 4.4.

Table 4.4 Demographic information of respondents

Demographic variables	*n* (%)
Age	Range between 32 to 42 years old
Education	
Bachelor's degree	6 (54.5%)
Masters's degree	5 (45.5%)
PhD	-
Working Experience	
>15years	5 (45.5%)
11 to 15 years	4 (36.4%)
5 to 10 years	2 (18.2 %)
Supervising Experience	
1 to 5 years	1 (9.1%)
5 to 10 years	5 (45.5%)
>10years	5 (45.5%)
Institution	
University	3 (27.3%)
Government Hospital	7 (63.6%)
Private practice	1 (9.1%)
The number of FEES training hours provided to students each semester	
1 to 5 hours	3 (27.3%)
6 to 10 hours	3 (27.3%)
11 to 15 hours	1 (9.1%)
>15 hours	4 (36.4%)

FEES interpretation is taught to:	
Year 3 students	3 (27.3%)
Year 4 students	8 (72.75)

4.3.2 Procedure

The survey was distributed through an online platform (Google Form) only. An online invitation and link to participate in this survey were sent in WhatsApp group of Speech-Language Pathologists Association of Malaysia (SPEAK), SLT dysphagia workshop group, and SLT university alumni. The survey was distributed three times, with two-week intervals between each distribution as reminders. For internet-based surveys, sending reminders to potential respondents is important to improve the response rate (Burns et al., 2008). The project information sheet and consent information (see Appendix C) were included as the first page of the online survey form. Due to the nature of online surveys, respondents were considered to have provided consent by continuing to answer and submitting the survey.

4.3.3 Data Analysis

Statistical analysis for Section B: Clinical Incompetencies among SLT Students during Dysphagia Training was performed using the Statistical Package for the Social Sciences (SPSS), version 25. To measure the internal consistency of the item, Cronbach Alpha was computed. Descriptive analysis of the item and mean scores of each category were also calculated. The percentage of high-occurrence incompetencies among speech-language therapy students was calculated based on the two highest rating categories in the scale (Dzulkarnain et al., 2019). The RM-ANOVA was conducted to examine the differences of the mean score of errors between the eight categories in Section B. The alpha value was set to 0.05 and the p-value less than 0.05 was considered significant. The Greenhouse-Geisser was used as tests of within-categories effects to check the presence of significant differences between the categories. Next, pair-wise comparisons with Bonferroni corrections were performed to determine which pairs of mean scores

were significantly different. In addition, effect size calculations were performed to complement the *p*-value, as it provides essential insights for result interpretation (Field, 2018). The Pearsons's *r* effect sizes were computed using the formula developed by Rosenthal (1991):

$$r = \frac{z}{\sqrt{N}}$$

Cohen's (1988) guideline were used for effect size interpretation as in the Table 4.5 below:

Table 4.5 Interpretation of Pearson's r value

Pearson's *r*	Effect Size
0.1 - <0.3	Small
0.3 - <0.5	Medium
0.5 and above	Large

The open-ended questions in Section C: Opinion on Speech-Language Therapy Students' Challenge during Dysphagia Clinical Training, and Section D: Opinion on Teaching Using Simulated Learning Environment (SLE), were analyzed qualitatively using thematic analysis. The general rules in conducting thematic analysis were followed according to the approach by Braun and Clarke (2006). The steps for the analysis are portrayed in Figure 4.2.

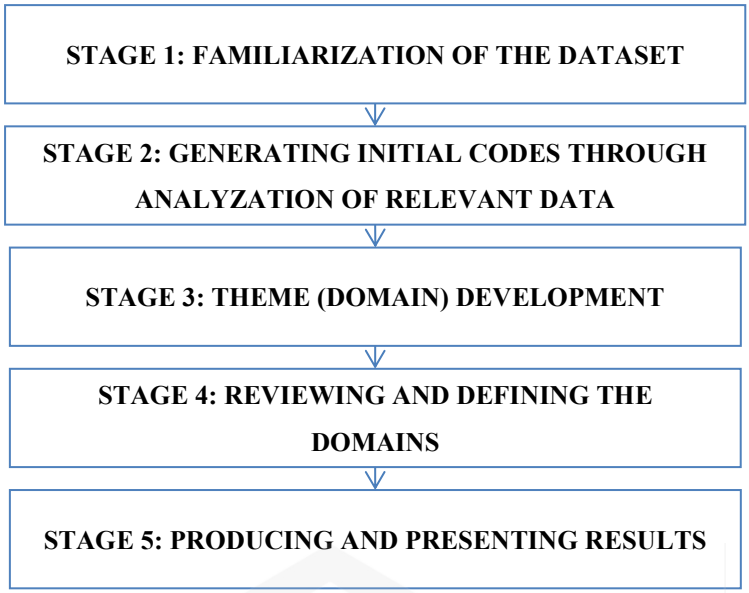


Figure 4.2 The workflow of thematic analysis for open-ended questions in Section C and Section D

The first crucial step in conducting thematic analysis is familiarizing oneself with the dataset. This process allows researchers to develop preliminary ideas and better align with the research focus (Terry et al., 2017). Following a thorough analysis of the relevant data, initial codes were generated. For this study, the initial codes for Section C and Section D were transcribed as analysis units. These units were then grouped into appropriate themes and subthemes based on the survey questions. To ensure accuracy, the themes and subthemes were reviewed alongside an independent SLT. Definitions for each domain were discussed, and some rewording was carried out to enhance clarity and cohesion.

4.3.4 Results

4.3.4.1 Reliability Analysis of the Categories in the Survey

Since reliability analysis could not be performed during the pre-testing stage due to the small sample size of only three participants, the analysis was conducted during the survey administration stage. Reliability was calculated using Cronbach alpha.

According to DeVellis (2003), any Cronbach's alpha value above .7 is acceptable. For items in Section B, the Cronbach alpha coefficient was .964 indicating good internal consistency.

Further reliability analysis on each category was consistent with the initial internal consistency, with the Cronbach alpha values ranging from .749 to .883, indicating acceptable to excellent reliability (Table 4.6).

Table 4.6 The reliability analysis of the 44-items in each category

Category	**Cronbach Alpha**	**Items**
Case History	.749	5
OME	.826	5
CA and HLE	.883	5
Water and Food Test	.843	6
FEES	.872	5
Management and Plan	.849	6
Case Note	.863	4
Professionalism	.795	8

4.3.4.2 Analysis of Clinical Incompetencies among Speech-Language Therapy Students during Dysphagia Training

Two types of analyses were conducted to examine the clinical incompetencies made by speech-language therapy students: descriptive analysis and a comparison of mean scores across different categories. These analyses are explained in the following subsections:

4.3.4.2.1 Descriptive Analysis of Section B: Clinical Incompetencies among Speech-Language Therapy Students during Dysphagia Training

The percentage occurrence of the types of incompetencies among speech-language therapy students was calculated and is presented in Table 4.7. For Case History, the respondents agreed that the most common incompetency among speech-language students was their inability to probe for further details from patients or caregivers (63.64%). The highest reported incompetency was the inability of speech-language therapy students to relate OME findings to cranial nerve functions, with 90.91% of respondents identifying this issue. From the data analysis, respondents also agreed that incompetencies were most frequently observed in relation to: 1) deciding if a patient passed or failed the test in relation to OME findings (72.73%); 2) relating FEES findings with cranial nerve functions; 3) integrating the results from all the assessments conducted (72.73%) and; 4) inability to make accurate impression or differential diagnosis (81.89%)

Table 4.7 Table 4.7 Percentage occurrence of different types of incompetencies among SLT students in dysphagia training.

No	Item	% occurence			
		Not at all	Rarely	Occasionally	Frequently
CASE HISTORY					
1	Unable to conduct a comprehensive history taking.	-	9.09	45.45	45.45
2	Unable to give simple and clear questions.	9.09	9.09	54.55	27.27
3	Using jargons and medical terms with the patient and/or caregivers.	-	27.27	45.45	27.27
4	Unable to rephrase questions when patients and/or caregivers find it difficult to understand.	-	27.27	54.55	18.18
5	Unable to probe for details and further data/ facts from patient's given information.	-	-	36.36	63.64
ORAL MOTOR EXAMINATION					
1	Demonstrate wrong technique when examining the patient.	18.18	18.18	63.64	-
2	Unable to give correct/appropriate instructions to the patient.	18.18	36.36	36.36	9.09
3	Unable to relate the findings with cranial nerve functions.	-	-	9.09	90.91
4	Incorrect placement of utensil (e.g. use of tongue depressor).	18.18	36.36	45.45	-
5	Unable to relate the findings to determine the type of instrumental assessment to be conducted.	-	18.18	36.36	45.45
CERVICAL AUSCULTATION (CA) AND HYOLARYNGEAL EXCURSION (HLE)					
1	Unable to palpate the correct structures.	-	-	63.64	36.36
2	Unable to differentiate normal or abnormal hyolaryngeal excursion.	-	9.09	54.55	36.36

3	Incorrect placement of the stethoscope	-	27.27	36.36	36.36
4	Unable to listen to swallow sounds using a stethoscope.	-	27.27	54.55	18.18
5	Unable to relate findings from the observation to a possible diagnosis.	-	-	27.27	72.73
WATER AND FOOD TEST					
1	Unable to decide which consistency to be prioritized when testing with the patient.	-	9.09	72.73	18.18
2	Unable to handle patients with sufficient care to ensure safety.	9.09	18.18	18.18	54.55
3	Unable to differentiate types of food/drink consistencies.	18.18	45.45	27.27	9.09
4	Unable to prepare the exact drink/food consistencies using food thickener.	18.18	18.18	36.36	27.27
5	Unable to decide if a patient passed or failed the test in relation to OME findings.	9.09	9.09	9.09	72.73
6	Unable to decide indication for instrumental assessment.	-	27.27	27.27	45.45
FIBERENDOSCOPIC EXAMINATION OF SWALLOWING (FEES)					
1	Unable to give correct/appropriate instructions to the patient.	-	36.36	9.09	54.55
2	Unable to relate the findings with cranial nerve functions.	-	-	27.27	72.73
3	Unable to identify the correct anatomical structures.	-	27.27	9.09	63.64
4	Unable to interpret the findings from the observation.	-	9.09	27.27	63.64
5	Unable to give feedback to patient and/or caregivers.	-	9.09	27.27	63.64
MANAGEMENT AND PLAN					
1	Unable to integrate the results of all the assessments conducted.	-	-	27.27	72.73
2	Unable to interpret the findings to determine a correct diagnosis.	-	-	36.36	63.64
3	Unable to use the findings to determine a comprehensive plan for the patient.	-	9.09	45.45	45.45
4	Unable to explain the result to the patient.	-	49.09	63.64	27.27

5	Unable to use layman terms when explaining results to the patient.	-	18.08	36.36	45.45
6	Unable to recommend referrals to other professionals if necessary.	-	9.09	45.45	45.45
CASE NOTE					
1	Unable to come with correct impression or differential diagnosis.	-	9.09	9.09	81.89
2	Unable to write correct notes.	-	18.18	45.45	36.36
3	Unable to write clear notes.	-	18.18	63.64	18.18
4	Unable to write comprehensive notes.	-	9.09	36.36	54.55
PROFESSIONALISM					
1	Patient was not greeted when entering the room.	36.36	54.55	9.09	-
2	Unable to maintain good manners with the patient.	72.73	27.27	-	-
3	Unable to conduct assessment in appropriate sequences.	18.18	36.36	27.27	18.18
4	Unable to maintain hygiene when dealing with patients.	27.27	27.27	27.27	9.09
5	Unable to provide consultation using layman terms.	-	18.18	63.64	18.18
6	Unable to maintain a comfortable distance from the patient.	36.36	54.55	9.09	-
7	Unable to appear confident during assessment and result delivery.	-	27.27	27.27	45.45
8	Taking inappropriate time (e.g., too much time or too fast) during assessment.	9.09	27.27	36.36	27.27

Next, the percentage of frequently occurring incompetencies among students was calculated across the different categories. A summary of these results is presented in Figure 4.3. The highest incompetency rate was observed in the management and plan category (92.41%), followed by the CA and HLE category (87.27%) and the case note category (86.36%). The case history and FEES categories also showed high incompetency rates (83.63% and 83.64%, respectively). In contrast, the lowest occurrence of incompetency was recorded in the professionalism category (39.87%).

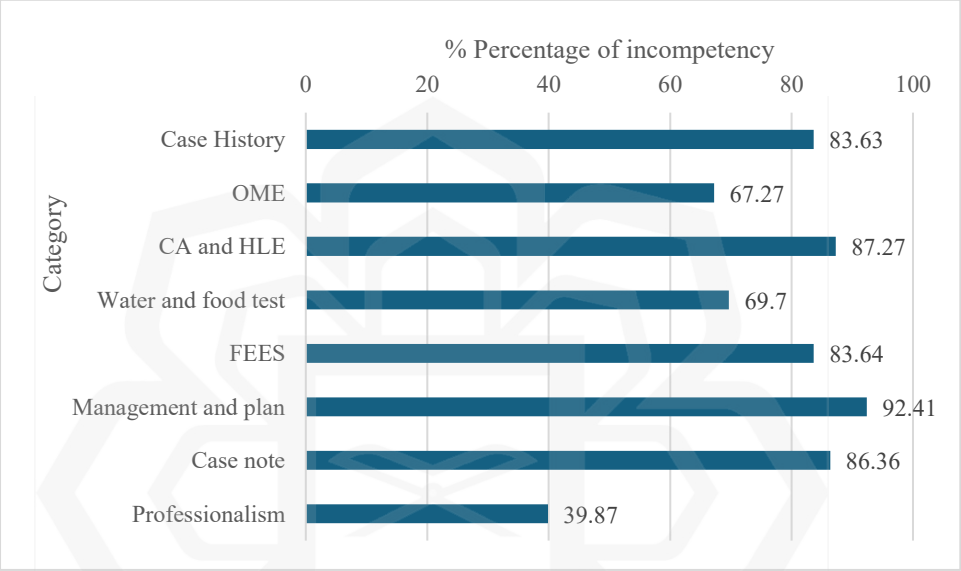


Figure 4.3 Percentage of high-occurrence incompetencies across categories

4.3.4.2.2 Mean Scores for Categories in Section B

Based on Table 4.8 and Table 4.9, a summary of incompetencies in these tested categories revealed that the highest common incompetency was recorded from the FEES category and management and plan category. The results were not significant ($p>0.005$), but the effect size was large. The top three highest mean scores were in the categories of FEES (Mean= 3.473, SD=0.628) and management and plan (Mean=3.424, SD=0.472), followed by case note category (Mean=3.341, SD= 0.573) and CA and HLE category (Mean=3.273, SD=0.531). The lowest incompetency occurrence was in the professionalism category (Mean=2.307, SD=0.530).

Table 4.8 Comparison of mean score based on category

Category	Range	Mean Score	Standard Deviation (SD)
Case history	2.2 – 3.8	3.182	0.510
OME	1.8 – 3.4	2.855	0.580
CA and HLE	2.6 – 4.0	3.273	0.531
Water and food test	1.67 – 4.0	2.985	0.710
FEES	2.2 – 4.0	3.473	0.628
Management and plan	2.5 – 4.0	3.424	0.472
Case note	2.25 – 4.0	3.341	0.573
Professionalism	1.38 – 2.88	2.307	0.530

Table 4.9 Post-hoc analysis of the eight categories

(I) Category	(J) Category	p-value	Cohen-d	Effect size
Case history	OME	.213	0.59876654	large
	CA and HLE	1.00	-0.17479633	small
	Water and food test	1.00	0.318696803	medium
	FEES	1.00	-0.98068231	large
	Management and plan	.493	-0.49250308	medium
	Case note	1.00	-0.29313325	small
	Professionalism	.000*	1.682381245	large
OME	CA and HLE	.094	-0.75174445	large
	Water and food test	1.000	-0.20053468	small

	FEES	.000*	-1.02237202	large
	Management and plan	.001*	-1.07609322	large
	Case note	1.00	-0.84300267	large
	Professionalism	.003*	0.98638717	large
CA and HLE	Water and food test	1.000	0.459387698	medium
	FEES	1.000	-0.34392270	medium
	Management and plan	1.000	-0.30057712	medium
	Case note	1.000	-0.12309935	small
	Professionalism	.002*	1.820922848	large
Water and food test	FEES	.110	-0.72808091	large
	Management and plan	.305	-0.72819377	large
	Case note	1.000	-0.55181232	large
	Professionalism	.010*	1.082205815	large
FEES	Management and plan	1.000	0.088208285	small
	Case note	1.000	0.219586682	small
	Professionalism	.000*	2.006643942	large
Management and plan	Case note	1.000	0.158114887	small
	Professionalism	.000*	2.225815146	large
Case note	Professionalism	.007*	-1.87346357	large

4.3.4.3 Results for Thematic Analysis of Section C: Opinion on Speech-Language Therapy Students Challenges during Dysphagia Clinical Training

Based on the thematic analysis, the challenges faced by SLT students were expressed in two perspectives, either related to student or related to clinical environment. Under the challenges related to student themes, there were four subthemes which are lack of (1) theoretical knowledge, (2) lack of application of knowledge into practice, (3) lack of training in report writing and (4) lack of confidence. Whereas there are three themes

emerged for recommended solution for the abovementioned challenges which are; (1) to provide more training, (2) to improve theoretical knowledge and (3) to provide and encourage the usage of advanced facilities. All the emerging themes and subthemes are summarized in Table 4.10. Regarding the most difficult challenge question, the majority of clinical educators (72.72%) identified a lack of confidence and difficulty in applying theoretical knowledge to practice as the most commonly encountered issues.

Table 4.10 Thematic analysis of Section C: Opinion on speech-language therapy students' challenges during dysphagia clinical training

Question	Theme	Subtheme	Examples of Analysis Unit
List down the challenges faced by your students during dysphagia training.	Challenges related to student	Lack of theoretical knowledge	unfamiliar with medical terminology, lacking knowledge on dysphagia, unable to explain normal swallowing process
		Lack of application of knowledge into practice	failing to apply theoretical knowledge, unable to link diagnosis with swallowing issues, struggling to integrate theory into practice
		Lack of training in report writing	lack of training in report writing and documentation
		Lack of confidence	lack of confidence, afraid
	Challenges related to clinical environment	Lack of opportunity to meet dysphagia patient	reduce learning opportunity, rarely seen dysphagia case, hours and experienced
		Lack of opportunity to conduct instrumental assessment	reduce exposure to instrumental assessment, observation and conduct instrumental assessment

		Lack of advance tools	no specified dysphagia lab, lack used of mannequin, no access to advance instrument
What would be your recommended solution(s) to the above challenge(s)?	Provide more clinical training	Increase clinical hours for seeing dysphagia patient to graduate	more hands on and observation session, specified logbook for dysphagia, more practical session
		Attachment at facilities with more dysphagia patient	exposure to different severity cases, attachment
		Enhance application of theoretical knowledge to practice	teach student how to plan management, hypothesis, relate to assessment findings.
	Improve theoretical knowledge	Encourage independent learning	read
		Provide adequate class/lecture	subject
	Provide advance facilities/ encourage usage of advance facilities		lab, mannequin and instruments

4.3.4.4 Results for Thematic Analysis of Section D: Opinion on Teaching Using SLE

SLE was a new term for most of the respondents. While only 36.4% of respondent agreed that they have heard about SLE before the short explanation in the survey, none of them claimed to have applied or used SLE in their teaching. Regarding changes in teaching methods, 36.36% of clinical educators reported incorporating more practical activities, 27.27% mentioned integrating multimedia tools, 18.18% stated they introduced case studies, and another 18.18% reported using demonstration in their teaching. The themes and subthemes to the questions related to SLE are presented in Table 4.11. Four themes emerged as the positive aspects of SLE to be applied in dysphagia teaching which were; improve understanding of knowledge, improve practice frequency, improve confidence level and improve teaching and learning experience. Similarly, four themes emerged regarding the negative aspects of SLE: variation in realism, limited carryover, restricted exposure to real patients, and the risk of being wasted if underutilized.

One of the respondents were not sure what to be included in SLE, while the remaining suggested to include the clinical components of instrumental assessment (50%), rehabilitation intervention (40%), OME (40%), CA (20%) and 20% on food trials preparation. When asked about case-based training SLE, respondents also agreed that it came with positive and negative aspects as presented in Table 4.11. The respondent believed that providing feedback was necessary when utilizing SLE. The types of feedback suggested by the respondents were summative feedback, formative feedback and operational feedback.

Table 4.11 Thematic analysis of Section D: Opinion on teaching using SLE

Question	Theme	Subtheme	Analysis Unit
What would be the positive aspects if SLE is to be applied in dysphagia teaching?	Improve understanding of knowledge	Improve theoretical knowledge	swallowing physiology, improve understanding
		Enhance clinical reasoning	anatomy, physiology and intervention, error and learning
	Improve practice frequency		practice
	Improve confidence level		use without being afraid, able to boost students' confidence, build up confidence level
	Improve teaching and learning experience	Session is enjoyable and interactive	enjoy
		Session is easier to conduct for novice	manageable, predictable
		Provide additional aid	visual aid
What would be the negative aspects if SLE is to be applied in dysphagia teaching?	Vary in realism		involvement of caregivers, no real patient
	Inability to carryover		unable to apply correctly in clinical
	Limit exposure to real patient		hours on SLE

	Wastage if underutilized		resources not optimize
Please share your opinion(s) if <u>case-based</u> training was to be applied virtually instead of using real patients (eg using computerized system and software).	Positive aspect	Good learning experience	great way of learning, interesting
		Suitable for theoretical knowledge	lecture and tutorial, understand
		Suitable for clinical application	good decision making, exposure
		Improve training accessibility	more chances to practice, standard cases or each student
	Negative aspect	May vary in realism	emotions, better with real patient
		Users engage in inorganic experience	soft skills
		Requires training	need to be trained, learn this method
Do you think it is necessary for the users to be given feedback when utilizing SLE? If yes, what kind of feedback should be provided?	Summative feedback		measure student knowledge's improvement
	Formative feedback		provide performance feedback on decision making, guide interpretation of

			results, give direct feedback
	Operational feedback		how to utilize SLE, explain the component and how to use

4.4 DISCUSSION

This study aimed to identify the clinical incompetencies among speech-language therapy students during dysphagia training, and the challenges encountered during the delivery of dysphagia training. In addition, clinical educators' knowledge and perceptions on SLE were explored. The findings are discussed in the following section.

4.4.1 Commonly Occurring Incompetencies in Dysphagia Training

The most frequently observed incompetencies among students were in FEES interpretation. Primary reasons for incompetency in interpreting FEES among undergraduate students include the procedure's complexity and specialized character. During clinical dysphagia training, students may only have the opportunity to observe FEES if their clinical placement is at a facility where the procedure is available, which limits consistent exposure. Moreover, FEES interpretations necessitate a profound comprehension of both anatomical and physiological aspects (Scholten & Russell, 2000). A study by Martin, Bessel and Scholten (2014) revealed that SLTs find that learning anatomy is particularly challenging. Consequently, mastering this knowledge requires significant time and effort, making it a common area of struggle for both practicing clinicians and students alike (Martin et al., 2014). In fact, an earlier study by Wooi, Scott, and Perry (2001) demonstrated that students' ability to interpret instrumental was strongly correlated with their performance images recognize anatomical structures. This explained why speech-language therapy clinical educators in this study reported a high frequency of incompetencies in students' ability to accurately identify anatomical structures and to interpret FEES findings appropriately.

Moreover, it is widely acknowledged that interpreting FEES is inherently challenging, even for experienced SLTs, and requires significant practice to attain proficiency (Colodny, 2002; Langmore et al., 2022; Pilz et al., 2016). Consequently, this research result is expected, as the difficulties associated with FEES interpretation closely align with the well-established challenges faced by both speech-language therapy students and practicing SLTs. Increasing opportunities for exposure, for example through the use of computer-based self-training materials that can be accessed at any time, may help address this issue by allowing students to practice without the need to work directly with real patients.

Another category with a high occurrence of incompetency among students during dysphagia training was management and planning. This is a crucial aspect of dysphagia care, as it requires students to integrate their clinical findings with appropriate rehabilitation interventions and patient-specific care plans. Further analysis of this category revealed that the most frequent incompetency was students' inability to integrate the results of assessments. Remarkably, the same high occurrence of this incompetency regarding result integration was observed in other categories, including OME, Water and Food Test, CA and HLE, and FEES. This finding indicates that most students' clinical incompetencies were associated with reasoning skills and their ability to connect theoretical knowledge with practical application. It underscores a gap in students' critical thinking and decision-making processes when transitioning from classroom learning to real-world clinical settings, as highlighted by Brackenbury et al. (2014).

These findings align with an earlier study by Scholten (2001), who interviewed 14 clinical educators and reported that the greatest challenge in teaching dysphagia to speech-language therapy students was their difficulty in making accurate interpretations and linking theoretical knowledge to practical applications. Scholten (2001a) and Brackenbury et al. (2014) suggested that such challenges can arise when students acquire knowledge in settings that primarily emphasized theoretical learning, making it harder to integrate and apply concepts in clinical contexts. Brackenbury et al. (2014) also noted that when theory and practice are not sufficiently interconnected, students may forget key information or fail to form meaningful links between different learning experiences. While Malaysian curricula generally incorporate practical components, difficulties in transferring theoretical knowledge into competent clinical practice have also been attributed to learner-level factors such as confidence, motivation, and

students' learning strategies (Fatima, Pallath, & Hong, 2025; Kosior,Wall & Ferrero, 2019). To help sustain students' motivation, Ball and Riquelme (2019) recommend incorporating innovative, multimedia-based approaches into teaching practices.

Other than that, the ability to make informed, self-regulatory decisions based on context and evidence is a key aspect of the reasoning domain. One suggested approach to enhance reasoning skills for dysphagia management is to incorporate case-based patient scenarios into the curriculum (Doeltgen et al., 2019). Through consistent exposure and exercises through illness scripts, which are comprehensive narratives that outline patient symptoms, history, and outcomes, students can develop a deeper comprehension of clinical patterns and decision-making processes (Doeltgen et al., 2019). Through the application of theoretical information to practical scenarios, this approach promotes critical thinking and enhances learners' capacity to develop patient-specific management strategies.

In addition to the previously mentioned categories, students also exhibited a high rate of incompetency in the case note category. These findings are interconnected with the challenges discussed earlier. When students lack a deep understanding of the dysphagia cases they encounter, they struggle to gather and synthesize the necessary information to arrive at a complete diagnosis and produce comprehensive case reports. A thorough dysphagia report necessitates proficient, concise, and accurate description of the activities carried out during a dysphagia case management (Murray, 2003).

Finally, CA and HLE also showed a high frequency of incompetency among speech-language therapy students. One contributing factor is the difficulty in correctly identifying the anatomical landmarks required for these assessments (Borr et al., 2007; Chi, 2019), which is challenging given that anatomy and physiology are already known as complex areas for students. Another possible reason for the high error rate in CA and HLE could be the variation in their application among practicing SLTs (Mathers-Schmidt & Kurlinski, 2003; Vogels et al., 2015). Due to this variability, some students may receive training in these techniques, while others may not, leading to inconsistent skill development. The controversy surrounding the reliability of CA, which involves listening to swallowing sounds with a stethoscope, adds to this inconsistency, as some studies have questioned its diagnostic accuracy (Borr et al., 2007; Zenner et al., 1995). However, when used in conjunction with bedside evaluation and assessment tools, CA has shown potential benefits (Bergström et al., 2014; Jaghbeer et al., 2023; Ferrucci et al., 2013). Similarly, HLE, when clearly defined and measured systematically, can serve

as an indicator of swallowing function and has the potential to enhance interpretation during dysphagia assessment when used alongside instrumental assessments. (Brates et al., 2019; Chi, 2019; González-Fernández et al., 2011). Thus, it can be concluded that while CA and HLE may be challenging, they remain valuable components of dysphagia management training.

4.4.2 Challenges during Dysphagia Clinical Training

Challenges in dysphagia training were noted by clinical educators in this study as arising from either student-related issues or the clinical environment. Regarding student-related challenges, educators highlighted that student often lacked theoretical knowledge and struggled to integrate this knowledge into practical application, which consistent with the findings on the most common incompetency observed. As discussed in Section 4.4.1, this may relate to surface learning approaches, where students focus on reproducing information without fully integrating it into their clinical reasoning (Brackenbury et al., 2014; Scholten, 2001a). Even when practical training is incorporated into the curriculum, students may still engage in memorization primarily for examination purposes, limiting their ability to connect academic study with clinical application (Reid et al., 2005). Such learning patterns can affect long-term retention of theoretical knowledge and may reduce confidence when applying skills to dysphagia management in real clinical settings. Furthermore, clinical educators have indicated a deficiency in their training in report writing, which is directly linked to the significantly high occurrence of incompetency in the case note category. One possible explanation for this is that students usually acquire report writing skills mainly during clinical training (Staltari et. al., 2010), and their limited exposure to dysphagia patients may limits their chances to practice writing dysphagia case notes. Furthermore, the ability to clearly articulate clinical findings require strong critical thinking skills (Halvorson-Bourgeois et al., 2020; Murray, 2003) ,which already identified to be challenging among students. Halvorson-Bourgeois et. al (2020) proposed that enhancing clinical reporting necessitates the consistent use of a standardized rubric and feedback to assist students in recognizing their writing weaknesses and making improvements. Therefore, strengthening students' clinical reasoning through application-based learning activities is an essential step toward improving the quality of clinical reporting.

For challenges related to clinical environments, clinical educators reported that students often have limited opportunities to encounter dysphagia patients. This scarcity is likely because the majority of SLTs primarily handle pediatric language cases (Chu et al., 2019; Mustaffa Kamal et al., 2012a). Consequently, during clinical placements, the types of cases students encounter are heavily influenced by their supervisors' clinical caseloads (McAllister, 2005). Moreover, the ability to carry out instrumental assessments and utilize advanced tools is hindered by various factors, such as institutional financial constraints, insufficient working space, and the lack of expertise among clinical educators to facilitate instrumental evaluations, all of which have been identified as confounding factors contributing to this limitation (Mustaffa Kamal et al., 2015).

4.4.3 Clinical Educators' Knowledge and Opinion on Implementation of SLE on Dysphagia Training

Less than 50% of the clinical educators in this study reported familiarity with SLE, which aligns with the findings in the literature that SLE usage is still emerging in the field of speech-language therapy (Dudding & Nottingham, 2018; Macbean et al., 2013). Given the infrastructural constraints highlighted by Mustaffa Kamal et al. (2015), it is unsurprising that the availability of SLE in the Malaysian speech-language therapy curriculum is still restricted. Although the initial investment in SLE can be high, it is often considered cost-effective in the long run (Triola et al., 2006).

Nevertheless, clinical educators held the belief that including SLE into dysphagia training might greatly enhance theoretical understanding, foster clinical reasoning, expand practice opportunities, and enrich both teaching and learning experiences. Clinical educators perceived SLE as a prospective solution for the present challenges encountered in dysphagia training. However, concerns were raised about the variability in realism of SLEs and their ability to ensure carryover of skills into real-life practice. These findings underscore the critical aspects that need to be integrated into the development of the ISD. An effective learning tool must facilitate deep learning to ensure carryover of skills (Brackenbury et al., 2014; Entwistle, 1997). Additionally, realism and an enriched learning experience have been highlighted as key criteria for a successful SLE (Gaba, 2004). Clinical educators also emphasized the importance of

incorporating three types of feedback—summative, formative, and operational—into the SLE. Since feedback has been shown to significantly enhance learning (Epstein et al., 2002 ; Hattie & Yates, 2014), the development of the ISD should prioritize the inclusion of all these feedback types to maximize its effectiveness.

4.5 CHAPTER SUMMARY

This survey explored clinical educators' perceptions of the common clinical incompetencies among speech-language therapy students during dysphagia training, as well as the challenges encountered in delivering this training. The findings underscored specific focus areas for dysphagia training in speech language therapy students, particularly the need to integrate self-directed, interactive learning systems that promote reasoning and the application of theoretical knowledge through case-based studies. Additionally, dysphagia clinical educators identified key features to be incorporated into the newly developed learning tool using the SLE format, namely a sense of realism and the inclusion of feedback. Based on these inputs and suggestions, it is crucial to ensure that the ISD is tailored to meet the needs of the Malaysian speech language therapy context.

CHAPTER FIVE

PHASE II: THE ISD DESIGN, DEVELOPMENT AND IMPLEMENTATION

5.1 INTRODUCTION

As discussed in Section 4.4 on the challenges and incompetencies of SLT students, considering the challenges faced by Malaysian SLTs in terms of confidence, knowledge, and skills when managing dysphagia cases (Mustaffa Kamal et al., 2012b; Sharma et al., 2006), it is crucial to enhance speech-language therapy students' understanding and proficiency in dysphagia management, as discussed in Section 4.4. This can be achieved by improving dysphagia training and increasing students' exposure to dysphagia case management.

In response to difficulties in clinical practice and acquiring practical experience, complementary solutions are devised by implementation of SLE that replicate genuine clinical practice. In the absence of in-person clinical placement, the use of computer-based SLE could provide student exposure to standardized simulated patients and access to a wide range of diagnostic categories, therefore providing a comprehensive learning experience (Edelbring et al., 2011; Plackett et al., 2022). The availability of computer-based SLEs particularly developed for dysphagia training is currently restricted, despite their great potential (Bryan, 2022; Sia et al., 2016). Furthermore, to our knowledge, none currently available computer-based SLE cater to the common practice of the Malaysian setting, where CSE and FEES interpretations are more pertinent and commonly used (Mustaffa Kamal et al., 2012a). In response to this requirement, the objective of this sub-study was to create an interactive self-learning system known as the ISD.

As presented in the findings of Phase I (Chapter 4), clinical educators reported that the main challenges in implementing dysphagia training stemmed from speech-language therapy students' insufficient theoretical understanding and their difficulty in applying this knowledge in real-life clinical situations. This is further corroborated by the clinical educators’ opinion that speech-language therapy students demonstrated the

highest occurrence of incompetencies in the areas of FEES interpretation and management planning. Taking into account the input and suggestions from the clinical educators in Phase I (Chapter 4), the ISD has been developed to specifically address and meet the needs of the Malaysian SLT setting. In this chapter, the method of designing, development, and implementation of the ISD will be explained, followed by the results and discussion of the results.

5.2 METHODOLOGY

As previously mentioned, the current study adopted the ADDIE model to outline the method used. While the analysis phase has been detailed in Chapter 4, this chapter will focus on the design, development, and implementation phases. These steps will be further explained in the subsequent sub-sections.

5.2.1 Design Phase

According to the ADDIE model, the design phase should focus on developing clear and specific learning objectives that are informed by the findings of the analysis phase (Lioce et al., 2015; Peterson, 2003). This phase also involves creating the instructional content, selecting appropriate media, and determining the most effective instructional strategies to meet those objectives (Ganesan, 2015; Yee et al., 2018).

5.2.1.1 Learning Objectives of the ISD

Based on the data collected regarding students' incompetencies (refer to Chapter 4, Section 4.3.4), specific learning objectives were identified. The learning objectives of the ISD were crafted to enhance speech-language therapy students' ability to integrate clinical observations and findings while fostering their clinical reasoning skills. The learning objectives were;

Students will: i) analyze and interpret information obtained from the CSE and FEES, ii) determine an accurate clinical impression based on the clinical findings , and iii) identify appropriate intervention plans for the patient. It was understood that only

through an accurate assessment of these findings could students formulate comprehensive management plans tailored to the needs of dysphagia patients (McCullough & Martino, 2013).

5.2.1.2 The ISD Instructional Design

Following the learning objectives as above, the ISD was developed utilizing the case-based instructions (or Case-based learning; CBL). To support the development of clinical reasoning, incorporation of CBL to dysphagia management curriculum is suggested by Doeltgen et al. (2019). By utilizing real cases and establishing their relevance, this approach facilitated the connection between theory and practice (Doeltgen et al., 2019; McLean, 2016). This aligns with this study surveys' findings, which identified integrating theory into practice as one of the biggest challenges for students (refer to Section 4.3.4, Chapter 4). Application of CBL in the ISD provided students with enhanced exposure to step-by-step dysphagia patient management. The use of CBL in SLEs also has been discussed in Section 2.6.2.

To improve accessibility to the training, a computer-based simulated version of SLE was chosen as the modality. The use of computer-based SLE for patient management has been introduced since the 1990s (Lyons, Miller & Milton, 1998) and has been gaining popularity in health sciences and speech-language therapy specifically (Bryan, 2022; Carter, 2019; McLean, 2016) . The ISD was built to be accessed through an online platform. With the advancement of wireless technology nowadays, undoubtedly, the ISD would be easily accessible at students' conveniences.

5.2.1.3 Flow of the ISD

The content of the ISD was then organized to follow the flow and components of CSE beginning with identification of optimal patients' positioning, OME and cranial nerve interpretations (Leonard & Kendall, 2014; McCullough & Martino, 2013; MoH SOP, 2023). This was followed by assessment of CA and HLE, food and water testing, and interpretation of FEES clips (Chi, 2019; Langmore et al., 2022; Leder & Suiter, 2014, McCullough & Martino, 2013). Lastly, students were asked to choose the best possible

diagnosis and provide the best recommendations for the patient in terms of safest oral diet, and rehabilitation and/or compensatory technique (Leonard & Kendall, 2014; McCullough & Martino, 2013). The content of the ISD is as outlined in Table 5.1.

Table 5.1 Flow of the ISD

Topic	**Content/Subtopic**
Patient's Information	• NAME • Gender / Age / Status / Occupation • Height/Weight/BMI • Background (medical): • Complaint: • Date for swallowing evaluation and FEES:
Patient's positioning	• Position during sitting • Position during lying
OME	• Face, lips and jaw • Dentition and oral hygiene • Tongue • Palate • Vocal quality
Cranial nerves functions	• Trigeminal nerve (CN V) • Facial nerve (CN VII) • Glossopharyngeal nerve (CN IX) • Vagus nerve (CN X) • Hypoglossal nerve (CN XII)
Hyolaryngeal excursion and cervical auscultation	• Hand placement during HLE palpation • Stethoscope placement for HA
Food and water testing	• Dry and saliva swallows • Liquid consistencies and volume testing • Summary
Fiberoptic Endoscopic Examination of Swallowing (FEES)	• Video 1 – Structural observation of the larynx and pharynx

	• Video 2 – Swallowing observation • Video 3 – Swallowing observation
Results and diagnostic impression	• Summary • Symptoms and physiologic abnormalities • Clinical impression referring to symptoms
Recommendation	• Texture recommendation. • Compensatory technique • Rehabilitation technique • Others (i.e. repeat FEES) • Referring to other professionals

5.2.1.4 Types of Media Embedded in the ISD

SP images, videos, and sound recordings were strategically incorporated into the ISD to enhance its relevance and effectiveness. SP images and videos were utilized in various ISD topics, including the patient's background, patient positioning, and OME, as well as for CA and HLE topic. Additionally, videos demonstrating liquids of different consistencies were included in the food and water Test. Finally, FEES clips were provided for FEES interpretation.

5.2.1.5 Collection of FEES Videos

Before developing the ISD, a series of FEES videos was acquired from the ENT department at SASMEC. As detailed in Section 3.5; after obtaining ethical clearance from IREC and permission from SASRC, the collection of FEES videos began. The videos selected for this study were meticulously chosen from a pool of prerecorded FEES videos of dysphagia cases managed by SLTs in the ENT Department. For the

use in the ISD, the clips were cut using VN Video Editor according to tested liquid or food consistencies. The duration of the clips varies from five seconds to 60 seconds.

5.2.2 Development Phase

During the development phase, the creation and production of materials were made based on requirements derived from the analysis and design phases.

5.2.2.1 Case Selection and Development

Four clinical cases for the ISD were developed based on the real cases from pool patients who were treated by SLT in the ORL Department, SASMEC. The first case was swallowing procedure conducted in a patient without any swallowing disorders, while the other three were actual dysphagia cases. A real case was chosen rather than a simulated case because of the information accuracy and it can be adjusted to align with specific learning outcomes (Alinier, 2011). This information can then be incorporated into a standardized script (Alinier, 2011). Based on the collection of FEES videos database, cases were selected ensuring that the FEES videos were clear and of high quality. The information of the cases was then inserted into a template of standardized script for the ISD structured as in Table 5.1 (Section 5.2.1.3). The background summary of each case was presented in the Table 5.2. Next, the content was validated by five clinical educators (the explanation is provided in Section 5.31). An example of form for validation can be seen as Appendix D. Expert validation is a critical step in enhancing conceptual fidelity within simulations, as emphasized by Lioce et al. (2015). This is to ensure the elements included in the created scenario is relevant. In addition, they were asked to assess the suitability of the cases used and to rate the difficulty of each case (refer appendix E).

Table 5.2 Case Summary

Case 1 (Mrs. Norma)
This is a case of a 43-year-old married female engineer who was referred from the medical department due to a history of multifocal infarct Cerebrovascular Accident (CVA) diagnosed two months ago. A recent CT scan on Mrs. Norma showed multiple cerebral infarcts in the left frontal cortex. Upon discharge, she was advised to continue feeding via a nasogastric (NG) tube due to the risk of aspiration. However, Mrs. Norma self-removed the NG tube and has been consuming food orally over the past three days. Mrs. Norma claimed that she has no problem with drinking and swallowing.
Case 2 (Mr. Farid)
This is a case of a 38-year-old married male officer presenting with complaints of food sticking in the throat, occasional bloating, and heartburn. He also reported feeling tightness in the chest after meals for the past 3 months. No other medical history is noted for this patient. Esophageal manometry results from the Gastroenterology team were normal.
Case 3 (Mr. Lee)
This is a case of 71-year-old married male pensioner with a medical history notable for pharyngeal carcinoma diagnosed in 2010. He had completed radiotherapy and has been under the care of ENT specialist since then. Mr. Lee presented with slurred speech and tongue fasciculation. Recently, he experienced a left temporo-parietal CVA, causing him to be fed via NG tube. Despite not being permitted, he has been consuming soft-blended diet orally. Unfortunately, these attempts are associated with episodes of coughing.
Case 4 (Mrs. Nadia)
This is a case of 70-year-old married housewife who was referred by the medical department due to a history of stomach ulcer, regurgitation, and symptoms of dyspepsia. Mrs. Nadia reported experiencing a sensation of choking after swallowing for the past few weeks, accompanied by the presence of phlegm in her throat. At home, she has been following a diet consisting mainly of water and porridge, although she finds thin fluids easier to tolerate than porridge. Furthermore, she noted difficulty in retaining solid foods after swallowing.

5.2.2.2 Images and Videos Development

As stated in Section 5.2.1.4, certain components of the ISD incorporated SP. Actors were recruited based on their suitability to represent each case. Before the formal recording process commenced, every actor received a copy of their script for review. The PI then led the actors through the script, offering feedback on the accuracy of their simulated symptoms. Each scenario was rehearsed at least twice prior to the start of the official recording session. All the recording taken place in Hearing and Speech Clinic, Jalan Hospital Campus, IIUM. Some images and videos were edited by the software engineer using Adobe Photoshop to enhance their effects and simulate dysphagia patient symptoms more realistically. Some of the images and videos were edited and improvised using Affinity Photo, Adobe Lightroom and VN Video Editor. During the content validation of the ISD, the five experienced dysphagia practitioners were also asked to rate the relevance of the images and videos used in each case. They were encouraged to provide feedback or suggestions for improvement.

Following the discussions with the supervisory team and the software engineer, a comprehensive storyboard for the ISD was developed to plan the layout. This storyboard, which served as the blueprint for the interface design, was initially created using PowerPoint® (Microsoft®). The storyboard served as a reference tool for the software engineer during the development process. Examples of the storyboard screenshot were shown as in Figure 5.1 and Figure 5.2.

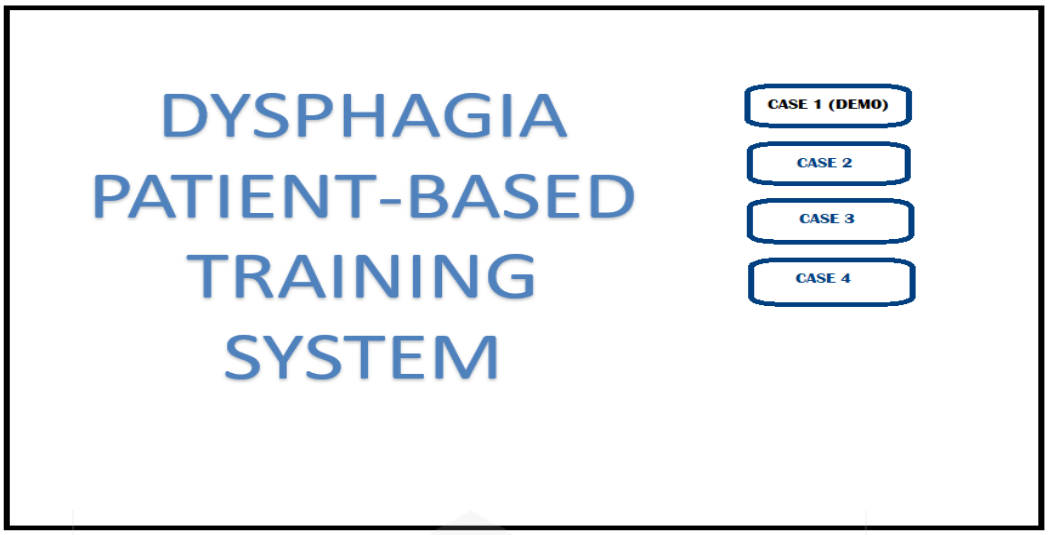


Figure 5.1 Storyboard of the main interface

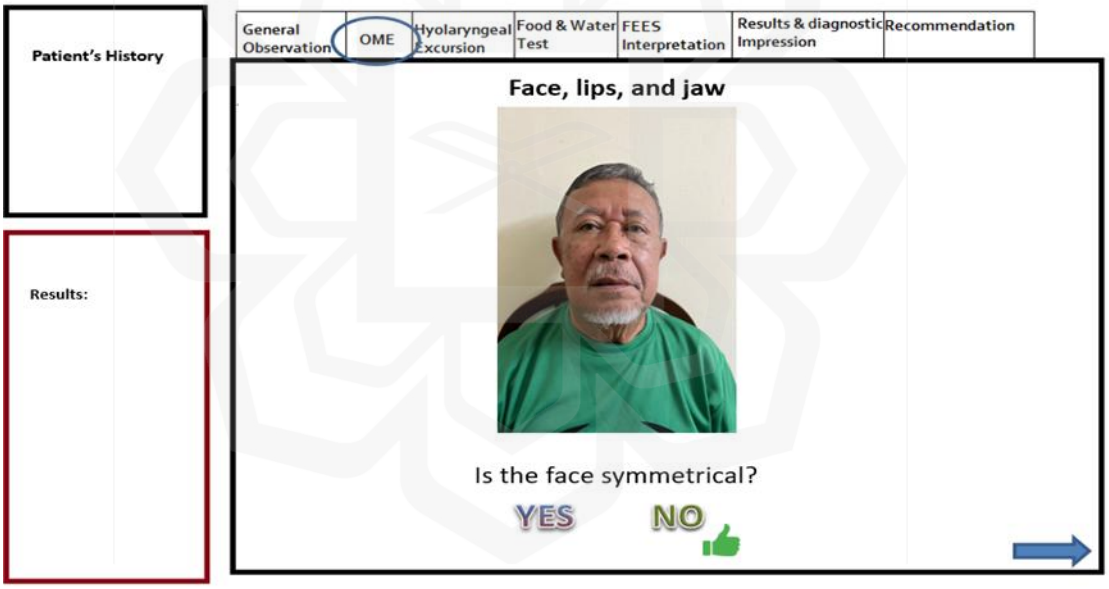


Figure 5.2 Storyboard of the content interface

5.2.2.3 The ISD Interface

Based on the storyboard, the ISD was developed using 3DVista Virtual Tour and Insta360 Studio. These software tools were selected to create 3D virtual images, replicating the experience of being in a real speech therapy clinic environment. This replication of the physical environment, referred to as "physical fidelity," is a key factor

in enhancing the authenticity of the simulation, as outlined by Lioce et al. (2015). Unlike virtual reality (VR), which uses animation to promote realism, 3D virtual tools utilize exact forms to mirror real-world settings.

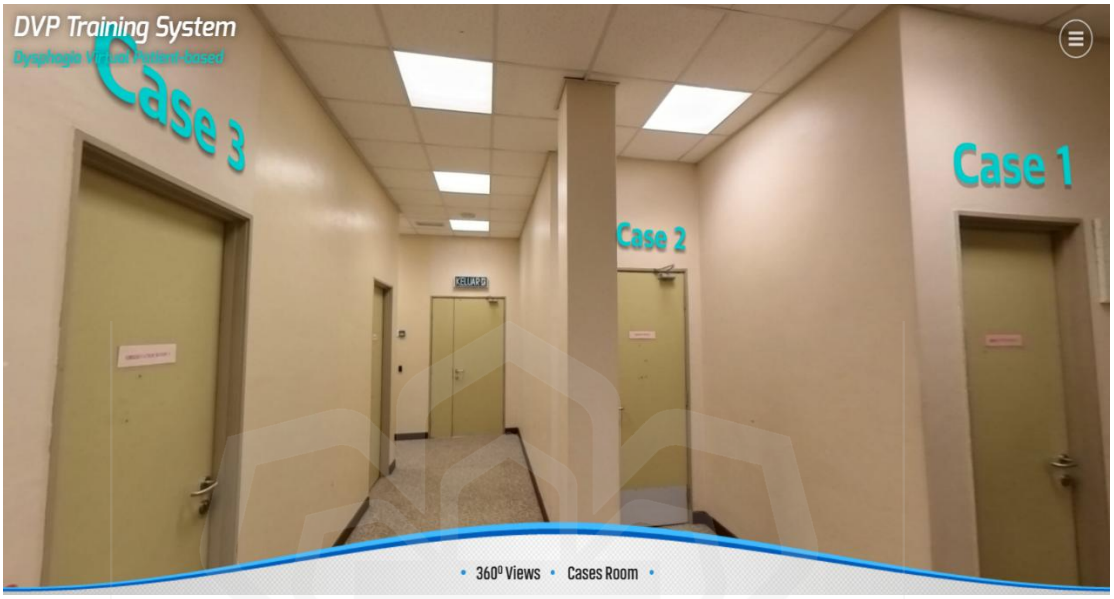


Figure 5.3 The ISD main interface

The ISD interface was completed following thorough discussions and multiple trials. Figure 5.3 showed the screenshot of the main interface. Each door represents one dysphagia case. The user must complete Case 1 before gaining access to Case 2 and subsequent cases.

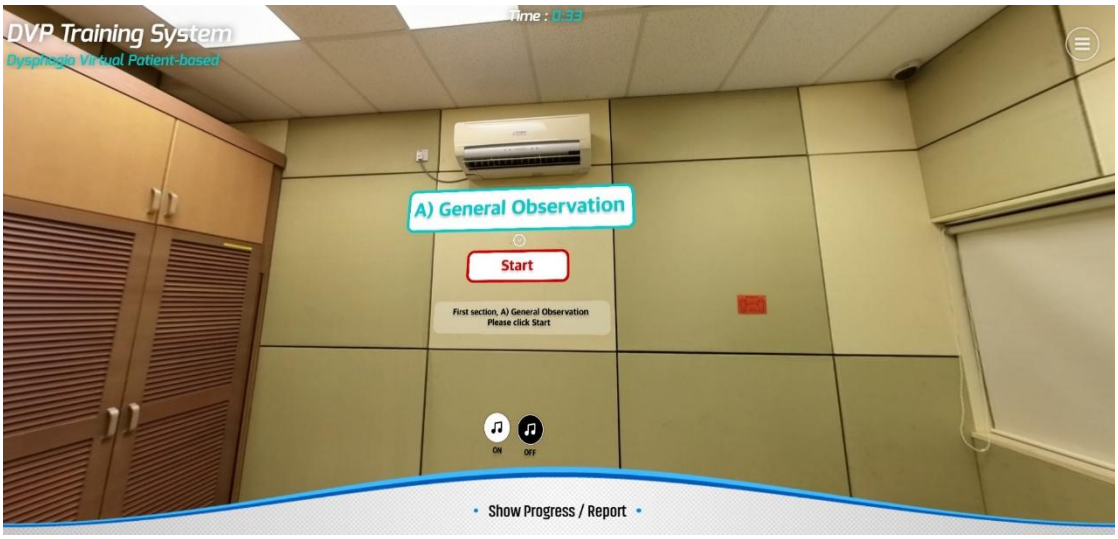


Figure 5.4 Topic interface

Figure 5.4 shows the topic interface. Upon entering each case room, the user received a notification indicating the specific topic they were in. To initiate every topic, the user could simply click on the start button.

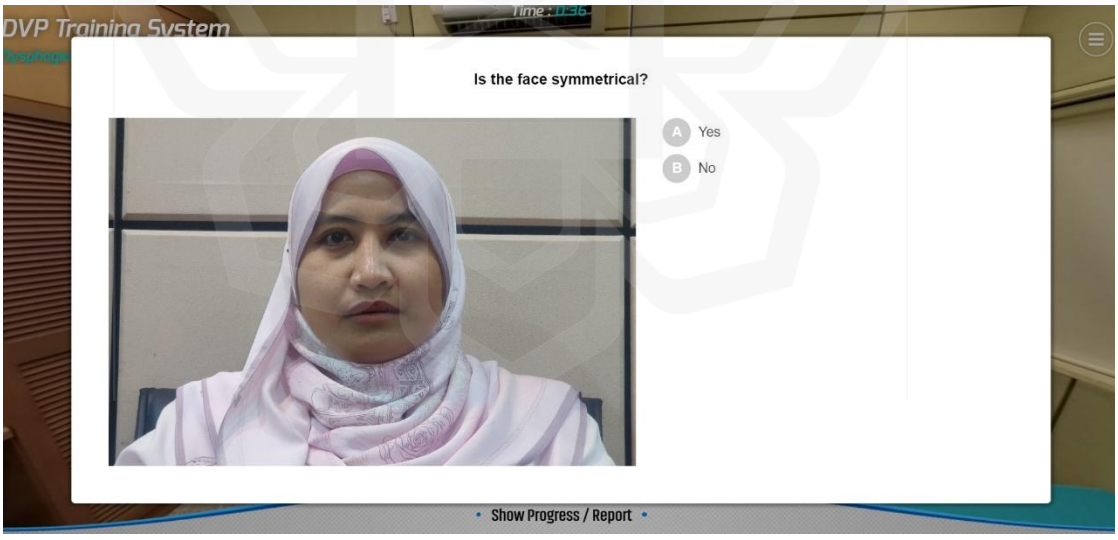


Figure 5.5 Example of item in the topic

Next, the user was presented with photos or videos and asked to make judgments based on their observations. An example of the item presented in the topic interface were showed in Figure 5.5.

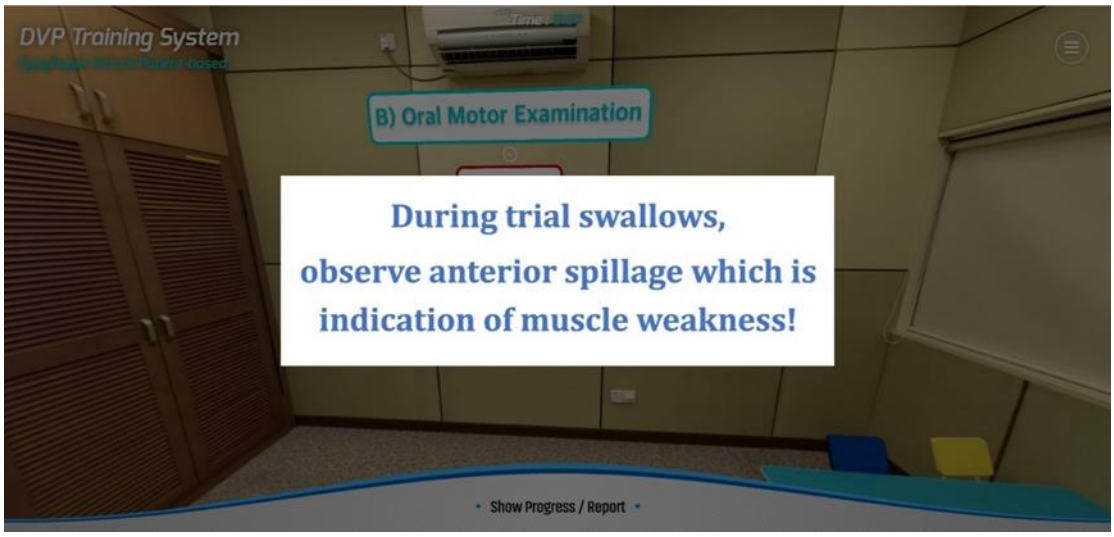
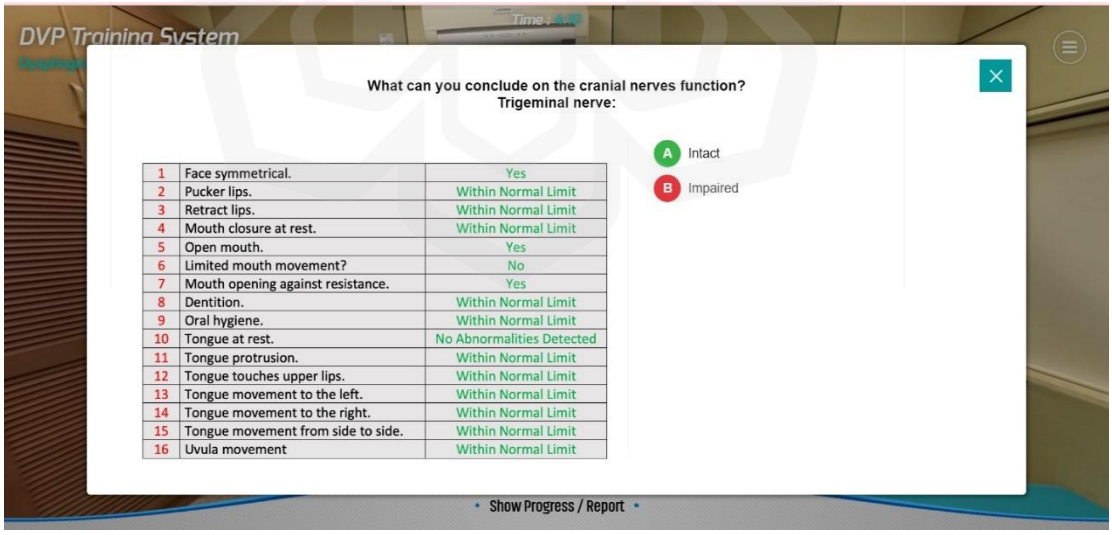


Figure 5.6 Informative feedback

A comprehensive array of feedback was included in the ISD to enhance learning outcomes. This feedback encompasses direct formative feedback, which provides immediate guidance and suggestions for improvement, as well as summative feedback, which offers results of overall assessment in each section. An example of informative direct feedback is shown in Figure 5.6



1	Face symmetrical.	Yes
2	Pucker lips.	Within Normal Limit
3	Retract lips.	Within Normal Limit
4	Mouth closure at rest.	Within Normal Limit
5	Open mouth.	Yes
6	Limited mouth movement?	No
7	Mouth opening against resistance.	Yes
8	Dentition.	Within Normal Limit
9	Oral hygiene.	Within Normal Limit
10	Tongue at rest.	No Abnormalities Detected
11	Tongue protrusion.	Within Normal Limit
12	Tongue touches upper lips.	Within Normal Limit
13	Tongue movement to the left.	Within Normal Limit
14	Tongue movement to the right.	Within Normal Limit
15	Tongue movement from side to side.	Within Normal Limit
16	Uvula movement	Within Normal Limit

Figure 5.7 Visual feedback through green (correct) and red (wrong) button

An example of summative feedback is presented in Figure 5.7. Upon completion of the OME topic, the user was presented with a concise summary of accurate

observation findings. Subsequently, the user must formulate a conclusion regarding the function of the cranial nerves. Visual feedback was given by a green button to show a correct answer and a red button to show an incorrect one.

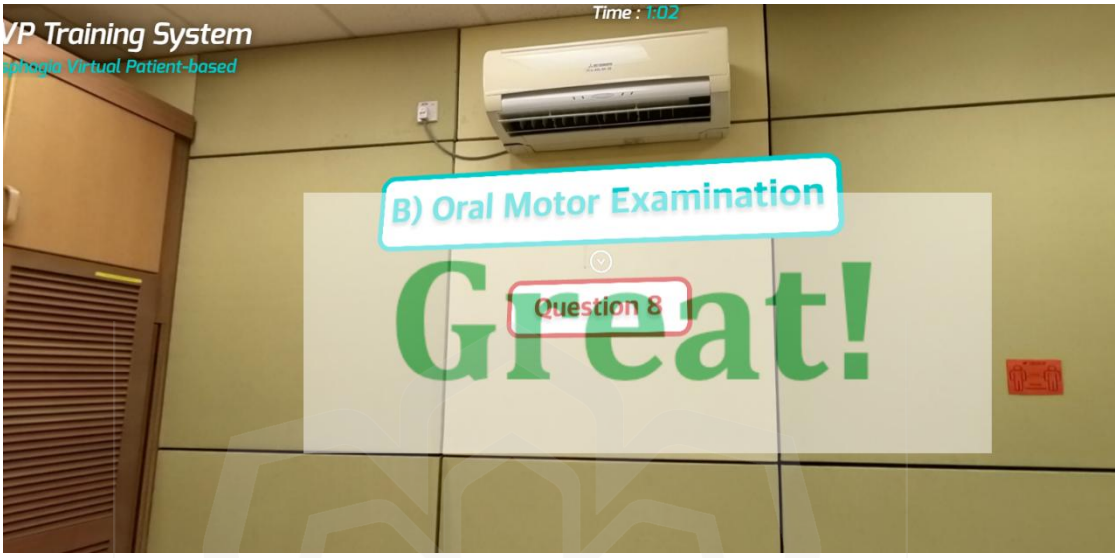


Figure 5.8 Motivational feedback

Figure 5.8 illustrates the motivational feedback incorporated into the ISD. This feedback was included to encourage students throughout their learning journey, promoting sustained engagement and a positive learning experience. By integrating motivational feedback along with other types of feedback, the ISD aims to enhance students' understanding and proficiency in dysphagia assessment and management, ultimately supporting their overall learning objectives.

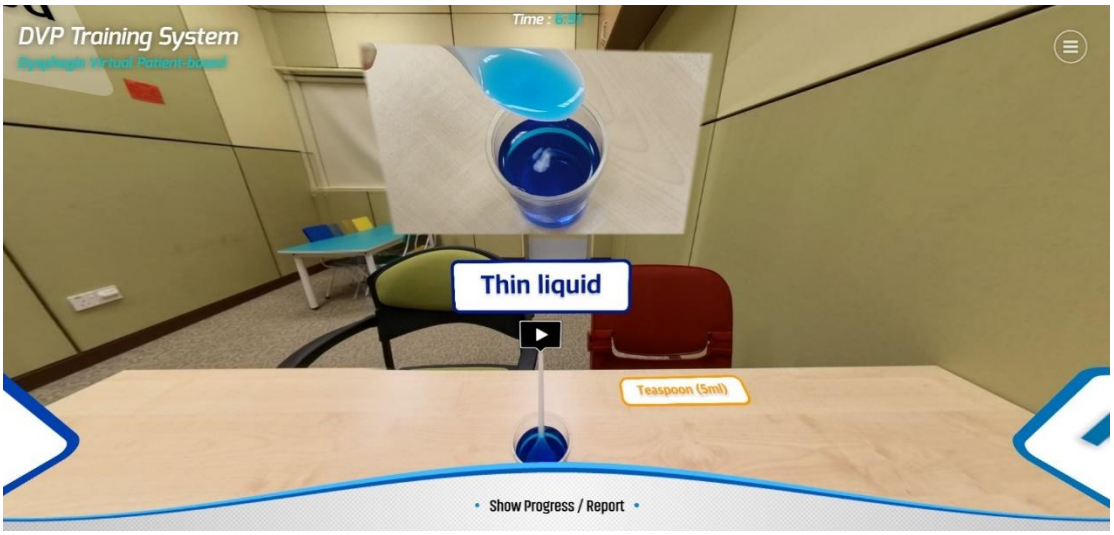


Figure 5.9 Videos of liquid consistencies.

Finally, Figure 5.9 shows an example of the incorporation of informative videos into the ISD. These videos were included to allow users to clearly visualize the intended items through playback. As presented in Figure 5.9, users could scroll through to view various types of liquid consistencies used during food and water testing.

5.2.2.4 Expert's Validation of Content and Materials

The validity of both the cases and its accompanying materials was evaluated through expert validation. Five clinical educators with specialized training in dysphagia or a minimum of five years of experience in managing dysphagia patients were carefully chosen from a range of professional backgrounds, including universities, government hospitals, and private institutions. Additionally, all of them had experience in supervising undergraduate students. The inclusion criteria of expert validators were similar to those of the experts recruited for Phase I (refer to Section 4.2.3, Chapter 4). The number of experts for content evaluation was based on the recommendation by Lynn (1986). The experts were asked to utilize the ISD and provide validation for the cases and materials used in the study. To validate the ISD, the technique of obtaining content validation index for instrument by Polit & Beck (2016) was adopted. This approach was chosen to ensure a more comprehensive validation of a newly developed module (Hamid et al., 2021), for this research, the content of the four cases and its materials. The content validation includes the relevancy of the information, sentences,

images, and feedback in each case. The experts were asked to rate the relevancy based on a 4-point scale (1 = not relevant, 2 = somewhat relevant, 3 = quite relevant, 4 = highly relevant) as proposed by Davis (1992). The item level content validity index (I-CVI) and scale level content validity index (S-CVI) were calculated using the same formula as mentioned in Section 4.2.4.2. For subjective evaluation, the experts were invited to provide comments or suggestions on each item. Subjective evaluation refers to the overall perspectives of experts regarding the extent to which the items accurately represent the domain content (Polit & Beck, 2016). Moreover, the experts were asked to complete additional questions regarding cases difficulties and suitability. An example of content validation form for the ISD can be found in Appendix E. The number of items for each case varied, ranging from 177 to 200 items, depending on the amount of written feedback included in each case.

5.2.3 Implementation of the ISD

For the study, the ISD was trialed on a small group of participants. According to the ADDIE framework, this is a type of continuous evaluation during the development process to determine if the newly develop instructional design could achieve its goals or require modification (Peterson, 2003).

5.2.3.1 Participants

Five SLTs from the Speech-Language Pathology Clinic, Kulliyyah of Allied Health Sciences, IIUM, and the ENT Clinic in SASMEC were invited to use the ISD. These participants were selected based on their professional qualifications and foundational knowledge of dysphagia management gained during their clinical training and academic preparation, making them suitable candidates to evaluate the system's usability and functionality. Their role at this stage was to assess the technical aspects of the ISD, which aligns with the implementation phase of instructional design, where usability and operational readiness are typically prioritized (Gunaydin & Karamete, 2016; Lu, Schmidt, & Shin, 2025). During the implementation phase, they were invited to complete the User Acceptance form.

5.2.3.2 User Acceptance form

The User Acceptance Form (Appendix F) was derived from Mohd and Shahbodin's (2015) study, in which it was employed to assess improvement needs for a multimedia prototype prior to the real testing stage. Similarly, in this study, the User Acceptance Form was used to evaluate the functionality of the ISD and verify that the prototype met the requirements of the end users before final evaluation. The User Acceptance Form comprised 13 items distributed across four domains, namely perceived ease of use (4 items), multimedia element (4 items), navigation (2 items), and functionality (3 items). An open-ended recommendation was additionally requested in the form.

5.2.3.3 Procedure

The initial study was conducted at the Speech-Language Pathology Clinic, Kulliyyah of Allied Health Sciences, IIUM with the presence of the PI. Prior to testing, participants were provided with a link to the ISD. They were then invited to utilize the ISD using their own preferred devices, such as a tablet, phone, or computer.

5.3 RESULTS

5.3.1 Content Validation of the ISD

As explained above, the validation for the content of the ISD was performed by five clinical educators. The findings of the content validity evaluation showed that the I-CVI for each content was 1.00. The overall S-CVI/Ave for the cases in the ISD was 1.00. Thus, it could be concluded that the items in the four cases have high content validity. Based on Lawshe (1975), if the number of validators is five or less, the I-CVI value should be at least 0.99 to be accepted. Therefore, all items in the script were retained. The result is presented in Table 5.3. Following the qualitative analysis, some amendments were made which will be explained in the next section.

Table 5.3 I-CVI and S-CVI for cases in the ISD

	Item Number	I-CVI	S-CVI/Ave
CASE 1	1-177 (177 items)	1.00	1.00
CASE 2	1-200 (200 items)	1.00	1.00
CASE 3	1-184 (184 items)	1.00	1.00
CASE 4	1-194 (194 items)	1.00	1.00

5.3.2 Feedback from Validators and the ISD Refinement

Despite the high I-CVI and S-CVI values, minor revisions were made following validators' comments and suggestions. The summary of their feedback and refinement is shown in Table 5.4.

Table 5.4 Revisions made for items in the ISD case

Case/Section	Initial Version	Improved Version	Remarks
CASE 1 Background information	Case of multifocal infarct CVA, 2/12 ago.	Case of multifocal infarct CVA, 2/12 ago. CT scan result showed multiple cerebral infarcts in the left frontal cortex.	Added information.
CASE 1 Background information	The patient removed **his** NG tube and has been on oral feeding since three days ago.	The patient removed **her** NG tube and has been on oral feeding since three days ago.	Grammatical error. The correct pronoun for a female patient is her.

CASE 1 OME		Gag-reflex is present.	Added information.
CASE 1 OME		Gag-reflex information should be used with caution. It is normal for certain individuals to not have a gag-reflex response.	Added information (Pop-up feedback)
CASE 1 Food and Water Test	Laryngeal displacement observation: **Appeared good, adequate for a swallow.**	Laryngeal displacement observation: **Within normal limit.**	Changed of term used.
CASE 2 OME		Gag-reflex is present.	Added information.
CASE 2 CN Functions (Feedback on CN V trigeminal)	Patient shows weaknesses on lips retraction and jaw movement!	The patient shows weakness in jaw movements.	Split feedback between CN V trigeminal and CN VII facial functions.
CASE 2 CN Functions (Feedback on CN VII facial)	Patient shows weaknesses on lip retractions and jaw movement!	The patient shows weaknesses on lips retraction.	Split feedback between CN V trigeminal and CN VII facial functions.
CASE 2 Food and Water Test	Laryngeal displacement observation: **Appeared**	Laryngeal displacement observation: **Within normal limit.**	Changed of term used.

	good, adequate for a swallow.		
CASE 2 Refer to other professional(s)	(/) Gastroenterologist	Removed.	Incorrect information. Patient was referred by the gastroenterologist.
CASE 3 OME		Gag-reflex is absent.	Added information.
CASE 3 OME	Listen to the voice quality: (/) **Harshness**	Listen to the voice quality: (/) **Roughness**	Changed of term used.
CASE 3 Food and Water Test	Laryngeal displacement observation: **Suspect reduced movement, inadequate for a safe swallow!**	Laryngeal displacement observation: **Limited movement observed.**	Changed of term used.
CASE 3 Food and Water Test	He presented with **hoarseness** and gurgly voice.	He presented with **roughness** and gurgly voice.	Changed of term used.
CASE 3 Rehabilitation technique		Pop-up feedback added: **Due to the health and/or physical limitations, SLT may consider alternative or modified techniques if patient cannot perform certain**	Added information.

		rehabilitation maneuver.	
CASE 4 OME		Gag-reflex is absent.	Added information.
CASE 4 Food and Water Test	Laryngeal displacement observation: **Appeared good, adequate for a swallow.**	Laryngeal displacement observation: **Within normal limit.**	Changed of term used.

5.3.3 Feedback on Suitability of Cases, Images and FEES Clips in the ISD

For the feedback on overall suitability of cases, images and FEES clips, the percentage of validators rated 'agree' and 'strongly agree' on each criterion was calculated. The percentage agreement based on criteria was presented in Table 5.5 below. Hundred percents of the validators agreed that the cases, images and FEES clips were suitable to be used for students' training. Therefore, none of the items were excluded from the ISD.

Table 5.5 Validators agreement on suitability of cases, images and FEES clips suitability

Criteria	**Score of Agree/ Strongly Agree** (%)
The **cases** in the ISD are suitable to be used for students' training.	100
The simulated patient **images** presented in the ISD are suitable to be used for students' training.	100
The **FEES clips** in the ISD are suitable to be used for students' training.	100

Regarding the difficulty of cases level, all the validators agreed that Case 1 and Case 2 were easy. The majority of the validators (80%) agreed that Case 3 and Case 4 were at moderate difficulty level while only one validator (20%) suggested that the cases were easy. The result of agreement on cases difficulty level was presented in Table 5.6 below.

Table 5.6 Table of percentage agreement on cases difficulty

Case	**Agreement on cases difficulty level** (%)		
	Easy	**Moderate**	**Difficult**
Case 1	100	-	-
Case 2	100	-	-
Case 3	20	80	-
Case 4	20	80	-

5.3.4 User Acceptance Result for Implementation Phase

Overall, all the SLTs acknowledged that the ISD was user-friendly and possessed good technological features. The percentage agreement on every item in the form is shown in the Table 5.7. From the result analysis, most item were rated either agree or strongly agree answers. However, 60% of the SLTs disagree that the ISD can be used without written instructions. As a result, a guideline was produced to address the comments on the need for written instructions to explore the ISD. The copy of guideline is attached in Appendix G.

Table 5.7 Percentage agreement result of user acceptance

Item	**Frequency**				
	1	**2**	**3**	**4**	**5**
	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
Perceived Ease of Use					
The ISD is interesting to use.				20%	80%
The ISD is easy to use.					100%
The ISD is interactive.					100%
The response feedback in the ISD is helpful.					100%
Multimedia Element					
Appropriate font type.					100%
Appropriate font size.				80%	
Appropriate colour.					100%
Appropriate background audio.			20%	20%	60%
Navigation					

Navigation is easy.				40%	60%
Navigation is clear.				40%	60%
Suitability					
The ISD is suitable to be used to train SLT students.					100%
The ISD is suitable to be used to test SLT students.					100%
The ISD can be used without written instructions.		60%		20%	20%

5.4 DISCUSSION

During the design phase, a concise document outlining the specifications of the ISD was prepared. This was followed by the completion of scripts, images, videos, and the storyboard during the development phase. The ISD was then subjected to clinical educators review for validation. In the implementation phase, a small-scale pilot study was conducted with SLTs. The primary objective of the ISD was to serve as a training tool for teaching dysphagia management to speech-language therapy students, with a specific focus on CSE and FEES interpretations.

Regarding the design of the ISD, a thorough literature review revealed no known computer-based dysphagia simulation studies that utilized comparable clinical measures. The choice to base the diagnosis and rehabilitation recommendations for dysphagia on the interpretation of FEES was made with careful consideration of the prevailing practices among Malaysian SLTs. Nevertheless, the development approach aligns with the broader trends in the development of SLE within the field of speech-language therapy (Bryan, 2022; Hewat et al., 2020; Sia et al., 2016).

The number of cases included in the ISD aligned with the scope of existing research on speech-language therapy simulation training programs. For instance, a previous study by Miles et al. (2016) included three simulated case-scenarios, while a more recent hybrid computer-based simulation study focused on VFSS interpretations by Bryan (2022) featured two simulated cases. These examples highlight the

consistency in case numbers across relevant studies in the field. Given that Case 1 in the ISD is a normal swallowing case, three dysphagia cases were included in the ISD.

The use of SP images and videos promotes realism and improved fidelity, which is one of essential aspects in simulation design (Gaba, 2004; Lioce et al., 2015). This approach enables students to learn clinical theory and skills in a safer environment. Studies have consistently reported that students gain enhanced confidence through participation in simulation-based learning (Bryan, 2022; Miles et al., 2016; Sia et al., 2016). Furthermore, technological advancements, such as the use of Adobe Photoshop, facilitate the customization and adjustment of images and videos to align with specific learning objectives. Consequently, the use of authentic cases is achieved without compromising patients' confidentiality.

The incorporation of feedback constitutes another critical component of the general learning process. Instructor's feedback has been shown to yield positive outcomes during training (Hattie & Yates, 2014; Issenberg et al., 2005). In the absence of a trainer, various types of feedback can be integrated into computer-based simulation training (Gaba, 2004). Additionally, multiple multimedia elements can be incorporated, such as visual and informative feedback, which engage users and potentially promote multisensory learning (Gaba, 2004). The flexibility of computer-based simulations also makes them well-suited for remote study, offering the convenience of learning in a comfortable environment (Gaba, 2004).

5.5 CHAPTER SUMMARY

The sub-study presented in this chapter aimed to design and develop an interactive self-learning system for dysphagia management called the ISD. The final version of the ISD consisted of four cases, complete with a hard-copy guideline for the user. While the ISD was tested in terms of its readiness, the effectiveness of the ISD as a training tool has not been confirmed by this point. Therefore, the effectiveness of the ISD was investigated in the next phase, and will be presented in Chapter 6.

CHAPTER SIX

PHASE III (EVALUATION): INVESTIGATION ON THE EFFECTIVENESS OF THE ISD

6.1 INTRODUCTION

Previous studies have shown that the use of computerized SLE has enhanced the performance of students and healthcare providers in targeted training areas (Berman et al., 2016; Dzulkarnain et al., 2019; Forsberg et al., 2019), including in speech-language therapy (Carter, 2019; Stead et al., 2022). However, to our knowledge, dysphagia-focused computerized SLEs remain limited in availability (Bryan, 2022; Ferguson & Estis, 2018; Sia et al., 2016). Ongoing difficulties in clinical training and speech-language therapists' confidence in handling dysphagia show the need for educators to find new training approaches or tools to better support students learning speech-language therapy (Caesar & Kitila, 2020; Hill et al., 2021; Joginder Singh et al., 2011; Sheepway et al., 2011). Therefore, an interactive self-training system called the ISD was developed. The previous chapter detailed the development and content validation of the ISD. As a new tool, the ISD's effectiveness was not yet known. In the final phase of the current PhD project, the ISD was evaluated for its effectiveness. This phase will be elaborated in this chapter. The final phase of this study aimed to: (i) investigate the effects of the ISD in comparison to classroom-based training on students' application-based knowledge of dysphagia management, and (ii) evaluate the usability of the ISD.

6.2 METHODOLOGY

6.2.1 Study Design

This study utilized a pretest-posttest quasi-experimental design to assess the effectiveness of the interventions (Maciejewski, 2020). This design implemented the concept of training (or experiment) and control groups. In this design, one group

received the training, and the results of the training were obtained at the end of the study period. Another group received different training and underwent the same pre and post-tests (Campbell & Riecken, 1968; Maciejewski, 2020). The selection of this study design was based on its practicality in terms of implementation, expenses, and duration (Maciejewski, 2020). A non-inferiority approach was adopted to determine whether the ISD achieved outcomes comparable to classroom-based training, as the primary aim was to establish equivalence in effectiveness rather than superiority (Piaggio et al., 2006; Schumi & Wittes, 2011).

In this study, 10 Year Four undergraduate speech-language therapy students were separated into two groups; the ISD training group and the classroom-based learning group. Further explanation on sampling method and training procedures are provided in Sections 6.2.2 and 6.2.3. The training which included one pre-test and two post-test evaluations was completed in one day. Following the training, pre-post scores were calculated and any changes were examined. Other than that, students' motivation was compared between groups through the usage of Instructional Material Motivation Survey (IMMS[Keller, 1979]). System Usability Scale was used to obtain students' subjective perception of usability of the ISD.

6.2.2 Participants

6.2.2.1 Criteria of Participants

The inclusion criteria for the participants were they must be speech-language therapy students and must have already completed the dysphagia management course. Given that the ISD was designed to simulate the management of real dysphagia cases, it was imperative for the learners to possess a solid foundation of theoretical understanding related to the swallowing and the management of dysphagia cases. Considering that undergraduate speech-language pathology students at IIUM complete the dysphagia management course during their first semester of Year Four, the participants of the study were therefore recruited amongst the Year Four students.

6.2.2.2 Sample Size Calculation

The sample size was determined using the sample size calculation formula for the clinical trial as suggested by Charan and Biswas (2013). The formula used was as follows:

$$Sample\ size = \frac{2SD^2\left(Z_{\alpha/2} + Z_{\beta}\right)^2}{d^2}$$

The alpha (α) value in this study was established as less than 0.05, indicating that the observed outcomes were considered to be statistically significant if the probability of their occurrence by chance was less than 5% (Type I error), whereas 95% of the observed results were attributed to the intervention. The statistical power of a study was established at 80% to minimize the occurrence of type II errors, which referred to the failure to identify a significant difference when such a difference truly existed, with Zα/2 was equal to 1.96, and Zβ was equal to 0.84 (Charan & Biswas, 2013). The standard deviation (SD) and mean difference (d) were derived from a previous study by Triola et al. (2006), which had similar objectives and investigated the comparison of training using SP and virtual SP through a pre-and post-study design. Using α 0.05, and predicted power of 0.85, the minimum number of participants needed in each group was five. This study managed to achieve the minimum number of total participants, which was ten speech-language therapy students.

6.2.2.3 Recruitment of Participants

Due to the limited number of speech-language therapy students, all Year Four IIUM students were invited to participate in the study (i.e., 10 students). The study was advertised through the WhatsApp group of Year Four speech-language therapy students. All the students fulfilled the requirement of the study and agreed to attend the training session. The procedure of the training is explained in Section 6.3.

6.2.2.4 Sampling Method

The students were recruited based on convenience sampling method. Systematic random sampling was implemented during the group separation during the training. In this sampling procedure, the initial sample is chosen randomly, and the following units are selected systematically (Singh & Masuku, 2014). Therefore, in this study, the Year Four speech-language therapy students were randomly assigned to either the ISD training group or the classroom-based training group, based on their result during pre-test. This is to ensure both groups contained a mixture of students who received higher and lower scores during the pre-test.

6.2.2.5 Instruments for Evaluation

6.2.2.5.1 Assessment Sheet

Two sets of case-based assessment sheets, namely Case A and Case B were used as instruments to measure pre and post-test results (refer to Appendix K and Appendix L). Case A was administered in both the pre-test and one of the post-tests to evaluate the immediate learning effect on content directly addressed during training. In addition, Case B was introduced in the post-test phase to assess the transferability and generalization of the acquired knowledge to a novel scenario, consistent with assessment practices that emphasize application to unfamiliar contexts (Shavelson, 2013). The two cases used in the tests were validated by experts, along with four additional cases used in the ISD. The assessment questions were vetted by three subject matter experts (two university-based SLT involved in case validation, and one university academic specializing in dysphagia) prior to the training session. Vetting is a procedure to ensure exam questions are valid and of high quality (Hassan et al., 2016). The number of vetting committee members complied with the recommendations by Hassan et al. (2016). The MCQ format was selected as the assessment method due to its ability to offer a robust and reliable evaluation of knowledge and advanced cognitive abilities in a short time (Shete et al., 2015). To ensure the assessment captured application-based knowledge and analytical skills, yes/no questions were included and

designed to focus on clinical reasoning rather than simple recall. All questions were deemed to be of acceptable difficulty by the vetting committee. This is important because assessment questions must reflect what has been taught in the module (Hassan et al., 2016). Questions that are too easy or too difficult indicate poorly constructed assessments and will not effectively evaluate the required level of Bloom's taxonomy (Rehman et al., 2018). Google Form was used as the medium for assessment. Test A consisted of 10 sections and Test B nine sections with a total mark of 108 and 110 respectively. At the end of the training, the overall marks were converted to percentage.

6.2.2.5.2 System Usability Scale (SUS) Form

The System Usability Scale (SUS) is a commonly employed standardized survey developed by Brooke (1986) utilized to evaluate the subjective perception of usability of a product. The SUS was used in this study to obtain speech-language therapy students' perception on the usability of the newly developed ISD. SUS consists of ten questions with five-point Likert-scale measures that ranges from strongly agree to strongly disagree. An example of a question in the SUS for the ISD is, "*I think that I would like to use the ISD frequently*". A copy of the SUS is attached in Appendix M. For odd numbered questions, the score contribution was determined by subtracting one from the scale position. Conversely, for even numbered questions, the score contribution is determined by subtracting five from the scale position. The total score was determined by multiplying the sum of scores for each question by a factor of 2.5. The SUS total score ranges from 0 to 100, where the product scored less than 50 would be judged to be unacceptable, products rated from 50 to 70 to be marginal acceptable and product rated above the 70 score to be good and passable (Bangor et al., 2008;Sauro, 2011). For use in this study, three open-ended questions were added to the SUS sheet. These questions were added to investigate usability and identify any concerns regarding the newly developed computer-based instructions (Heitz, 2013; Ssemugabi & De Villiers, 2010). Specifically, participants were asked to state the negative and positive aspects of the ISD and suggest recommendations for improvement of the ISD.

6.2.2.5.3 Instructional Material Motivation Survey (IMMS)

The Instructional Material Motivation Survey by Keller (1979) is a 36-questions questionnaire that has been used widely in understanding peoples' motivation towards learning through instructional material (Cook et al., 2009; Song & Keller, 2001). The IMMS was built based on ARCS components (i.e., attention, relevance, confidence and satisfaction) and has been used widely to measure users' perceived motivation towards instructional materials (Liu & Chu, 2010). The IMMS questions were based on a Likert scale ranging from 1 (not true) to 5 (very true). After correcting for negatively phrased items, higher scores indicated higher motivation. The items in the IMMS were distributed across the following constructs: 12 items in attention construct, nine items in relevance construct, nine items in confidence construct, and six items in the satisfaction construct. A copy of IMMS for both training group is attached in Appendix N and Appendix O. According to Keller (1987), a good instructional material needed to be able to capture and maintain learners' attention, be relevant to their previous experiences and academic needs, improve learners' confidence in achieving learning goals and foster a sense of satisfaction in relation to their efforts. Thus, the IMMS survey was used in this study to evaluate potential disparities in students' motivation between the groups that received classroom-based training and the ISD training. The use of IMMS has been validated (Cook et al., 2009) and the scales has shown high reliability to be used in Malaysian population (Jamaluddin et al., 2020).

6.2.3 Data Collection Procedures

The data collection procedures for Phase III are summarized in Figure 6.1. A full day training was conducted at Tutorial Room 2 and Tutorial Room 3, Kulliyyah of Allied Health Sciences, International Islamic University of Malaysia. Prior to the commencement of the training day, participants were reminded to bring their personal laptop and mouse, while the provision of earbuds was facilitated by the researcher .

At the beginning of the training, the participants attended a general briefing on the training activities that was conducted in Tutorial Room 2. Participants were also required to submit hard copies of consent form attached to the research information sheets (refer Appendix H) and demographic information sheets (refer Appendix I)

during the training day. Following the briefing, a pre-test was conducted. Participants were asked to complete a quiz on Case A with no time restriction. However, they were prohibited from referring to notes or engaging in discussions with each other. Participants were kindly advised that there was no undue expectation of an accurate response, but they were encouraged to do their best. All the participants completed a quiz on Case A in within 30 to 45 minutes.

Following this, participants were assigned to two groups. A group consisting of five students participated in the completion of four dysphagia cases via the ISD with the monitoring of invigilator for any troubleshooting. Concurrently, another group consisting of five students underwent classroom-based training in a separate tutorial room. In the classroom-based training group, students were required to complete the same four dysphagia cases, which were displayed via a projector, and fill in their answers on a hard copy observation form (refer to Appendix J). The training progressed at the participants' pace and was completed within 4.5 hours. Students were allowed to ask questions throughout the session. The students also received immediate feedback from a clinical educator on their correct or incorrect answers during the training. Upon completion of the training, participants were required to undertake post-test assessments comprising a quiz on Case A, followed by a subsequent quiz on Case B. The assessments were completed at the participants' own pace within a two-hour timeframe. Both groups were also required to submit the completed IMMS sheet. The ISD group was required to submit the SUS sheet.

Following the completion of the training, the classroom-based training group was provided with the opportunity to utilize the ISD for self-directed practice at their own place for a period of two weeks. After this, they were instructed to submit the SUS sheet.

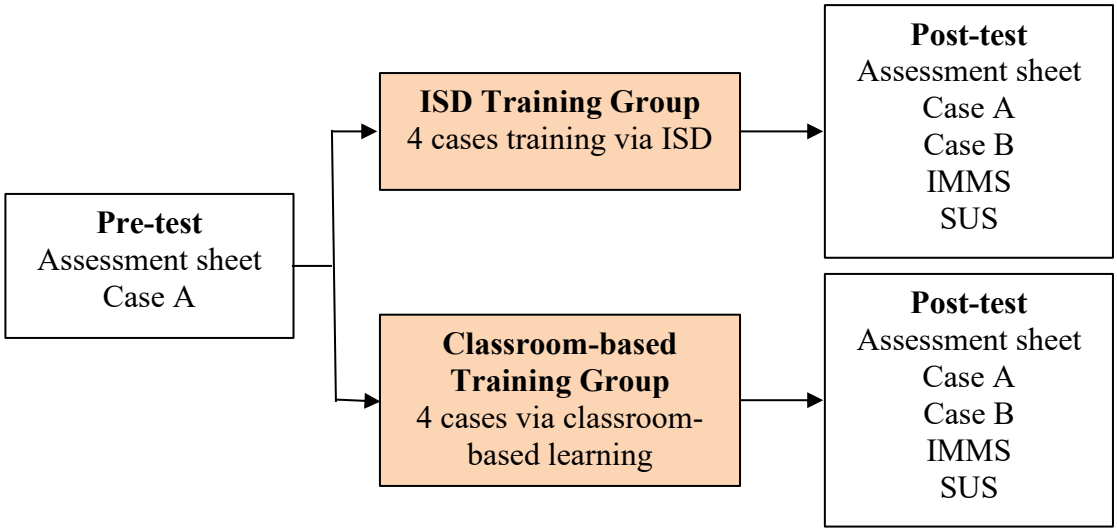


Figure 6.1 Flow of data collection procedures for Phase III

6.2.4 Data Analysis

The Statistical Package for Social Science (SPSS) Statistics Version 25 was used to analyze the data in Phase III. Prior to the statistical analysis, the collected data were assessed to determine if they met the assumptions of normality. The normality of the data was assessed based on three methods: (i) visual inspection of the histogram, (ii) evaluation of the skewness and kurtosis and (iii) performing a formal normality test using the Shapiro-Wilk test (Sharif, 2019). To classify the data as normally distributed, the histogram is supposed to have a symmetrical bell-shaped curve and the Q-Q plots should have a linear tendency. Other than that, the z-scores for skewness and kurtosis need to be between 1.96 and -1.96 and the p-value of the Shapiro-Wilk should be more than 0.05 (Sharif, 2019).

Referring to these methods, it was found that the data for Phase III could not meet the assumptions of normality. Therefore, non-parametric analyses, supplemented by descriptive analysis, were employed for statistical examination. The analyses used for every objective were summarized in Table 6.1.

Table 6.1 Summary of data analysis for Phase III

Objective	**Data analysis**	**Variables**
1. To investigate the effect of the ISD compared to classroom-based training on student's application-based knowledge of dysphagia management.	Mann-Whitney test	Pretest scores of the ISD training group and classroom-based training group Post test scores of the ISD training group and classroom-based training group
	Wilcoxon signed rank test	Pretest scores of the ISD training group and classroom-based training group. Post test scores of the ISD training group and classroom-based training group
	Descriptive analysis Mann-Whitney test	Percentage of improvement and the normalised gain score of pre-post training for the ISD training group and the classroom-based training group
2. To examine the usability the ISD.	Descriptive analysis	SUS scores
	Descriptive analysis Mann-Whitney test	IMMS scores

	Descriptive analysis	Positive feedback, negative feedback, and recommendations for the ISD

The Mann-Whitney test was employed to analyze the changes in pre- and post-test scores within both the ISD training group and the classroom-based training group. To compare the differences in improvement between the two groups, the Wilcoxon signed-rank test was computed. Additionally, the effect size was calculated to determine the percentage of variance or the magnitude of the difference between pre- and post-intervention testing, indicating the significance of the change (Rafieyan, 2016). A detailed explanation and interpretation of these results was already provided in Section 4.3.3. (Chapter 4).

To obtain the gain without much depending on the baseline score, the percentage of improvement and normalised gain (g-score) was calculated. The purpose was to evaluate the post intervention scores between the ISD and classroom-based training group, measuring the changes of improvement between groups.

The formula for percentage of improvement is as follow:

$$\% \text{ of improvement} = \text{Post-training test score} - \text{Pre-training test score}$$

The formula for g-score calculation is as below:

$$\text{g-score} = \frac{\text{Post-training test score} - \text{Pre-training test score}}{100 - \text{Pre-training test score}}$$

The interpretation of g-score is based on Hake (1998) as provided in Table 6.2 below:

Table 6.2 Interpretation of g-score

g-score	Interpretation
>0.7	High
0.3 – 0.7	Medium
<0.3	Low

Lastly, for the interpretations of the positive and negative feedback on the SUS form, thematic analysis was conducted. The procedure of the analysis also already explained in Chapter 4.3.3

6.3 RESULTS

6.3.1 Demographic Information

As mentioned in Section 6.2.2, this study comprised ten participants, each of whom had previously undertaken the dysphagia management subject in the preceding semester.

Table 6.3 showed the summary of participants' information. Participants were asked to rate their confidence in managing dysphagia cases and confidence in doing FEES interpretation based on the scale of (1) not confident to (10) very confident.

Table 6.3 Demographic information of the participants

	Range	**Mean (SD)**
Dysphagia management training (minutes)	180 - 3145	942.5 (921.77)
FEES observation (minutes)	60 - 600	255 (190.28)
Confidence in managing dysphagia cases (Likert scale 1 – 10)	3 – 9	5.4 (1.78)
Confidence in doing FEES interpretation (Likert scale 1 – 10)	2 – 6	4.6 (1.51)

6.3.2 Pre-test Comparison

The pre-test scores, dysphagia training duration, and FEES observation duration of both the ISD training group and the classroom-based training group were compared to evaluate any potential disparities prior to the implementation of the training.

Mann-Whitney test showed that the mean participants' pre-test scores was not significant ($p > 0.05$). Furthermore, the quantity of training hours and FEES observation hours were also no statistically significant different between the participants from the ISD training group and the classroom-based training group ($p > 0.05$). The summary of pre-test statistics can be seen in Table 6.4.

Table 6.4 Comparison of pre-test score, dysphagia management training and FEES observation duration received by participants.

Score	**Pre-Test Median**		**Mann-Whitney U Test**		**Size Effect (*r*)**
	Classroom-based training	**ISD training**	**Z**	***p*-value**	
Case A score (Pre-test)	66.4	63.6	-0.731	0.465	-0.231
Dysphagia management training (minutes)	495	1200	-1.362	0.173	-0.431
FEES observation (minutes)	360	180	-0.535	0.592	-0.169

6.3.3 Effectiveness of the ISD

6.3.3.1 Pre-test and Post-test Scores within Groups.

Wilcoxon Signed Ranked tests showed a significant higher median of post-test than pre-test scores in case A for both classroom-based training group, ($Z= -2.023$, $p<0.05$, $r=-0.640$) and the ISD training group, ($Z= -2.023$, $p<0.05$, $r=-0.640$) with large effect sizes,

suggesting that the score increased over time in both groups. A significant increase of approximately 6% and 2% was found in the post test score in comparison with the pretest score for the classroom-based training group and the ISD training group respectively. The summary of the results is displayed in Table 6.5.

Table 6.5 Pre-test and post-test A scores

Group	**Pre-test**	**Post-test A**	**Wilcoxon Signed Ranked Test**		**Effect Size (*r*)**
	Median	**Median**	**Z**	***p*- value**	
Classroom-based	66.4	72.7	-2.023	0.043	-0.640
ISD	63.6	65.5	-2.023	0.043	-0.640

Table 6.6 Pre-test and post-test B scores

Group	**Pre-test**	**Post-test B**	**Wilcoxon Signed Ranked Test**		**Effect Size (*r*)**
	Median	**Median**	**Z**	***p*- value**	
Classroom-based	66.4	74.1	-0.944	0.345	-0.299
ISD	63.6	68.2	-2.032	0.042	-0.640

However, for Case B post-test, Wilcoxon Signed Ranked tests only identified a significant difference in pre-test and post-test scores in the ISD training group for case B ($Z= -2.023$, $p<0.05$, $r=-0.640$) with large effect size. Meanwhile, no significant differences in pre-test and post-test scores for Case B was found in the classroom-based training group, $Z= -0.944$, $p<0.05$, $r= -0.299$ however, with medium effect size. Based on both analyses, a significant increase of approximately 8% and 5% was found in the post test score in comparison with the pretest score for the classroom-based training group and the ISD training group respectively. The summary of the result is displayed in Table 6.6.

6.3.3.2 Post-test Scores between Groups

The Mann-Whitney test showed that the differences in post-test scores for Case A between group of ISD training and classroom-based training was statistically not significant (Mann-Whitney = -0.529, p = 0.597) with small size effect (r=-0.167).

Noteworthy to that in Case B post-test scores, no statistically significant differences were found between the scores for the ISD training group and classroom-based training group (Mann-Whitney = -0.733, p = 0.463) with small size effect (r=-0.232).

6.3.3.3 Percentage of Improvement and Normalised Gain (g-score) Comparison between Groups

The percentage of improvement and normalised g-score was calculated to compare the effectiveness between both training groups. The descriptive analysis of the scores was summarized in Table 6.7.

Table 6.7 Percentage improvement scores and normalised gain (g-score) between group

Participant	**Improvement (%)**		**g-score**	
	Post-test Case A	**Post-test Case B**	**Post-test Case A**	**Post-test Case B**
Classroom-based training group				
1	10.9	15.1	0.285	0.395
3	0.9	-6.1	0.032	-0.216
5	3.6	7.7	0.107	0.229
7	19.1	21.4	0.412	0.461
8	1.8	-8	0.06	-0.267
Overall Median (IQR)	3.6 (13.65)	7.7 (25.3)	0.107 (0.303)	0.229 (0.670)
ISD training group				

2	9	16.7	0.202	0.372
4	1.9	0.3	0.053	0.008
6	9.1	4	0.286	0.125
9	11.9	4	0.397	0.109
10	2.8	10.4	0.068	0.253
Overall Median (IQR)	9 (8.15)	6 (11.4)	0.202 (0.281)	0.125 (0.254)

Table 6.8 Mann-Whitney test of the g-scores difference between classroom-based training group and the ISD training group.

		Pre-Test Median		**Mann-Whitney U Test**		**Size Effect (*r*)**
		Classroom-based training group	**ISD training group**	**Z**	***p*-value**	
g-score Case A	Post-test	0.107	0.202	-0.313	0.754	-0.099
g-score Case B	Post-test	0.229	0.125	-0.104	0.917	-0.033

In general, the classroom-based training showed an increase in percentage of improvement at Post-Test B. The individual participant data highlighted the spread of student's performance. However, two of participants in the classroom-based training group, namely Participant 3 and Participant 8 were identified to obtain negative gain in Post-test Case B. Based on Table 6.8, the highest g-score was from classroom-based groups (case B), followed by ISD training group (Case A), ISD training group (Case B) and classroom-based training group (Case A).

The g-score was further analysed using Mann-Whitney test (see Table 6.8). The effect size of the g-scores was calculated to measure the magnitude of the differences

between groups. The Mann-Whitney test showed that the mean differences in the normalized gain score between ISD training group and classroom-based training for Case A was statistically not significant (Mann-Whitney U = -0.313, p = 0.754) with small size effect (r=-0.099). Similarly with Case A, Mann-Whitney test result indicated no statistical differences between the scores for the ISD training group and classroom-based training group for Case B (Mann-Whitney U = -0.104, p = 0.917) with small size effect (r=-0.033).

6.3.4 IMMS (full) Scores

As aforementioned, all participants from both groups were asked to complete the IMMS questionnaire after the completion of their classroom-based or ISD training.

Table 6.9 Comparison of IMMS scores between groups

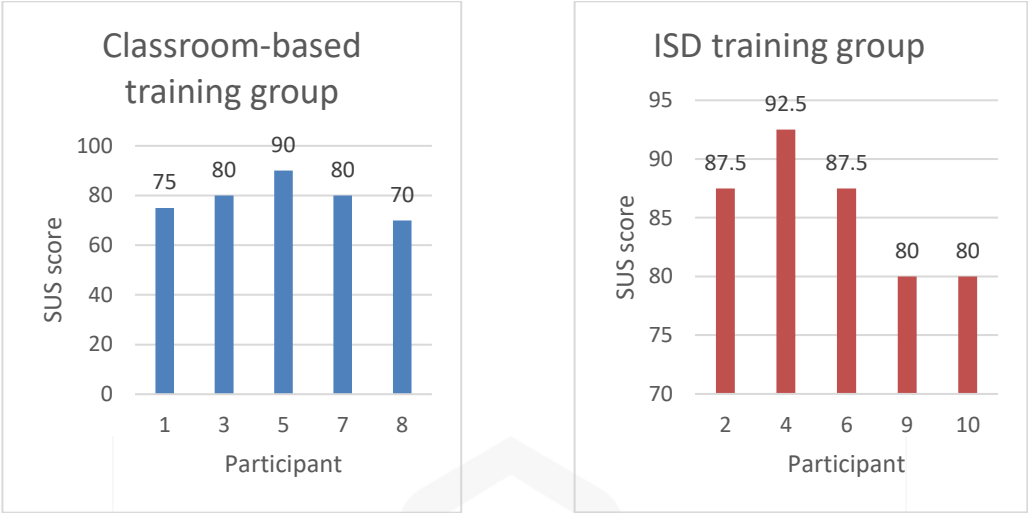
IMMS construct	Classroom-based training group		ISD training group	
	Range	**Mean (SD)**	**Range**	**Mean (SD)**
Confidence	3.3 - 4.6	3.96 (0.483)	3.3 - 4.6	4.10 (0.494)
Attention	2.9 - 4.8	4.18 (0.750)	3.7 - 4.8	4.31 (0.351)
Satisfaction	3.7 - 5	4.64 (0.541)	4.2 - 5	4.64 (0.351)
Relevance	3.8 - 5	4.60 (0.474)	3.9 - 5	4.40 (0.474)
Motivation	3.43 - 4.85	4.35 (0.538)	3.95 - 4.85	4.38 (0.406)

Table 6.10 Mann-Whitney U Test for domains in IMMS

IMMS construct	Median		Mann-Whitney U Test		Size Effect (*r*)
	Classroom-based training group	ISD training group	Z	*p*-value	
Confidence	3.9	4.1	-0.527	0.598	-0.167
Attention	4.4	4.6	-0.424	0.671	-0.134
Satisfaction	4.8	4.2	-0.324	0.746	-0.102
Relevance	4.7	4.2	-0.419	0.675	-0.132
Motivation	4.45	4.43	-0.210	0.834	-0.066

Table 6.9 shows the IMMS scores in both the ISD and classroom-based training group. According to the Mann-Whitney test there was no significant difference in each of the IMMS construct between classroom-based raining group ($p > 0.05$) and the ISD training group with small effect sizes and this is summarized in Table 6.10.

6.3.5 System Usability Scale (SUS) Scores



6.1 Percentage of SUS scores between groups

As aforementioned, all 10 participants completed SUS survey following their use of the ISD. As shown in Figure 6.2, the range of SUS scores for the classroom-based group were between 70 to 90 with mean 79 (SD=7.416) and the range of SUS scores for the ISD group were between 80 to 92.5 with mean 85.5 (SD=5.419). Such results indicated that the ISD has good usability, since it received a rating exceeding 68 from both groups (Sauro, 2011).

6.3.6 Student's Feedback on the ISD

Following the completion of the training and utilization of the ISD, participants were instructed to list three positive aspects of the ISD, three negative aspects of the ISD, and offer recommendations for enhancing the program. The feedback of the participants was discussed in each subsection.

6.3.6.1 Positive Aspect

The positive aspects of the ISD as described by the participants were categorized into four main themes. The summary is provided in Table 6.11.

Table 6.11 Positive feedback of the ISD

Aspect	Feedback
Utilization of several feedback mechanisms	1. Direct feedback 2. Informative feedback 3. Visual feedback 4. Adequate guideline
Systematic learning experience	1. Clear phase and flow of dysphagia management. 2. Easy to memorize
Realistic multimedia element	1. Simulated patients promote realness 2. Clear images and videos
Accessibility and good learning experience	1. Interactive and enjoyable software 2. Easy to use 3. Can be access anywhere

6.3.6.1.1 Utilization of Several Feedback Mechanisms

The majority of participants (n = 7, 70%) indicated that the positive component of the ISD stems from its utilization of several feedback mechanisms. One type of feedback received was direct feedback, which was feedback provided immediately after a question has been answered:

> Easy to know if the answer is right or wrong immediately (P1)

In addition to the aforementioned points, the feedback provided was informative and comprised an explanation for the correct answer provided. The examples of the comments are as follows:

It provides reasons for incorrect answers. (P3)

Have explanation to help student understand better. (P1)

Another form of feedback offered by the ISD was visual feedback, which included the use of emoticons and differentiated color coding:

> Simple color coding of red and green to indicate correct and wrong answers. (P2)

In addition, two of the participants agreed that adequate guidelines to utilised the ISD were provided. One of the comments is as follows:

> Adequate guideline provided. (P5)

6.3.6.1.2 Systematic Learning Experience

The ISD was established with the purpose of facilitating participants in engaging in a structured and organized learning experience. Thirty percent of the participants agreed that the ISD was well organized into distinct phases and showed good flow of dysphagia patients' management. Some of the feedback are as follows:

> The program shows good flow of dysphagia management procedure. (P9)

> Clear picture and phases. (P7)

One of the participants also commented that the repetition of procedures and the provision of feedback in the ISD aided in their retention of essential theoretical and clinical knowledge. The participant stated that:

> The repetition of the activity made me memorize the point. (P4)

6.3.6.1.3 Realistic Multimedia Elements

Another positive aspect of the ISD commented by the participants was the application of realistic multimedia elements including the clinical background and images of simulated patients to mimic the real clinical environment. Three participants agreed that

the usage of simulated patients enhances the authenticity of their experiential encounters. One of the positive comments from the participant was:

> Provide real picture of subject: increase realness in experience. (P2)

Two of the participants expressed satisfaction with the clarity of the images and videos utilized in the ISD. One of the comments was:

> Clear picture and video. (P8)

6.3.6.1.4 Accessibility and Good Learning Experience

One further facet of the ISD that was favored by the participants was its accessibility and how it provides positive learning experience. Forty percent of the participants claimed that the ISD was interactive and enjoyable software. One of the participants mentioned:

> Interactive learning tools for the student. It prevents student to feel bored during study. (P1)

The ISD was also rather straight-forward and easy to use. Some of the participants left the comments such as:

> Easy to use. (P7) (P10)

> Easy to be understood. (P4)

Furthermore, since the ISD was using an online platform, the ISD can be accessed from any location by mobile phones, tablets, or desktops. One of the participants commented:

> Can play the video from where we want to. (P8)

6.3.6.2 Negative Aspect

From the feedback of the participants, the negative aspects of the ISD could be classified into three primary themes. The overview of the aspect is presented in Table 6.12.

Table 6.12 Negative aspect of the ISD

Aspect	Feedback
Loading time	1. Took some time to load. 2. Need good internet connection.
Issues with feedback timing and length	1. Duration given is too short for some lengthy feedback.
Difficulty in rating OME	1. Difficult to predict strength and range of motion.

6.3.6.2.1 Loading Time

One of the constraints of the ISD, as commented by two participants, pertained to its loading time. The loading time of the interphases took some time. One of the participants made a comment:

> Need to be more patient (sometimes it took time to change from one activity to another). (P4)

Therefore, the ISD required good internet connection to improve the loading time. One of the feedback items from the participant was:

> Need strong internet connection. The internet connection will affect the time taken for the student to finish the task. (P1)

6.3.6.2.2 Issues with Feedback Timing and Length

Other than that, three of the participants claimed that the duration given was too short for some lengthy feedback. One of the comments was:

> There are times the passage was too long with given time to read. (P2)

6.3.6.2.3 Difficulty in Rating OME

One further drawback of the ISD as mentioned by two participants, was the challenge in evaluating oral-motor examination, to predict the strength and range of motion. One of the comments is as follows:

> Quite difficult to judge a patient's OME strength. (P10)

6.3.6.3 Recommendation

Finally, only 70% of the participants provided some recommendations for the ISD improvement. All the recommendations were based on technical aspects, as summarized in Table 6.13.

Table 6.13 Additional recommendation for ISD improvements

Aspect	Recommendation
Technical aspects	1. Operation without internet 2. Sign up or login feature 3. Close button option for feedback 4. Playback feature 5. Pause button

A participant proposed that the ISD be operated offline, without the use of the internet. The comment was as follow:

> ….it is very good if the tools do not need internet connection in order to operate it. (P1)

Another participant, suggested for sign-up or login feature to be included to utilize the ISD:

> Have sign up or login features so that the users can continue where they left and tract their records. (P8)

Following some negative comments regarding the feedback duration in Subsection 6.3.6.2, a few of the participants suggested for additional close button option for the feedback. Some of the comments were as follows:

> Increase time for duration of explanation or feedback or provide X button. (P6)

> May include a close button for additional explanation. Sometimes, it closes too early before I can finish reading it. (P3)

Another participant suggested for additional playback feature:

> For incorrect answers, it will be helpful to allow users look back at the questions and play back the video. (P3)

Finally, one participant suggested that pause button were included in the to improve the accuracy of the time recorded:

> Insert pause feature when answering the questions as some individuals may need to leave the software for a while but the time is still running. Hence, the time to answer the questions is not accurate. (P8)

6.3.7 Limitations of the ISD

Following student's feedback, Case I of the ISD was reviewed in collaboration with an expert, while the remaining three cases were self-reviewed by the researcher. A few other limitations of the ISD were summarized in this section. The limitations were divided into technical aspects as well as content aspects.

6.3.7.1 Technical Limitations

From a technical perspective, several issues were identified. One limitation of the ISD lies in its navigational design, which was structured to allow only forward progression from one section to the next. While this approach supports a more linear and guided learning pathway, it restricts users from revisiting earlier sections for review. Future development could enhance system flexibility by enabling non-linear navigation, thereby allowing learners to move more freely between sections as needed.

In addition, several case-specific issues were noted. For the normal case (Case I), it was recommended that the case be explicitly labelled as a “normal case” for practice purposes, to help students recognize its objective as a baseline comparison to dysphagic presentations. Furthermore, the processing times for certain multimedia elements were found to be suboptimal, consistent with negative student feedback reported in Section 6.3.6.2. In particular, some feedback text was displayed for too brief a duration to allow thorough reading, whereas other multimedia components required excessive time to load. Finally, a software bug was observed in Case I, where the interface experienced intermittent lagging and repetition.

6.3.7.2 Content Limitation

With respect to content, several areas require refinement. Across all cases, there were errors in clinical procedure. For instance, the assessment of dentition and oral hygiene did not consistently include open-mouth images, which are necessary to fully display the oral cavity. In the ISD, some aspects were also incompletely assessed. Lateral tongue movements were demonstrated, but neither rate nor duration were specified. As noted in Section 6.3.6.2, strength assessment relied solely on visual observation, which reduced accuracy and made interpretation difficult. Therefore, incorporating objective measures or information would strengthen the assessment. In addition, tasks such as puffing the cheeks or testing a volitional cough were omitted, yet these could provide valuable clinical information.

Next, in the Food and Water Test section, only liquid consistencies videos were demonstrated from spoon sips to cup drinking. The inclusion of single sip from a cup, together with video trials involving a broader range of food consistencies, would better represent clinical assessment practices.

Furthermore, terminology should be standardized for clarity and precision. The correct anatomical term to describe the movement is the velum rather than the uvula. .Other than that, the term *laryngeal displacement* should be replaced with *hyolaryngeal excursion (HLE)*, and descriptors such as *within normal limit* or *limited movement observed* should be reconsidered. While bedside laryngeal palpation remains a common clinical method, it lacks strong evidence, and perceptual judgments based on these terms should therefore be interpreted with caution. Finally, the term *texture modification* is

more appropriate than *diet modification*, as it better reflects recommendations typically provided by SLTs.

Regarding the FEES section, three out of 12 questions required revision or reconsideration. This is because certain parameters are difficult to evaluate using FEES. For example, oral propulsion cannot be observed. Similarly, questions on premature spillage and delayed swallow initiation are also challenging to interpret within the FEES modality.

At a more specific level, the case histories for Case 1 and Case 3 would benefit from a more coherent storyline, allowing students to extract key clinical information more effectively. Finally for Case 1, the image for tongue resting position was also unclear and should be revised to improve visibility.

6.4 DISCUSSION

This study evaluated the effects of the newly developed ISD on speech-language therapy students' performance and the usability. The outcome measures were compared within and between the group that received training via the ISD and the group that received classroom-based training in a one-day training session. In general, positive aspects were observed in speech-language therapy students' performance and motivation in both training groups, despite the differences in training methods. The findings are discussed in detail in the following sub-headings.

6.4.1 Effectiveness of the ISD

6.4.1.1 Improvement in Both Training Groups

One of the aims of this study was to examine the effect of the ISD, compared to classroom-based training, on students' application-based knowledge in dysphagia management. During pre-test, comparison has been made on students' baseline knowledge including prior experience in dysphagia management and FEES observation training and pre-test scores. Although students received different hours of clinical training prior to this study, the pre-test scores of the classroom-based training group and

the ISD training group showed improved achievement. Overall, the findings indicate that students who participated in either form of training developed an enhanced understanding of dysphagia management.

Further analysis of the performance of the ISD training group and the classroom-based training group among speech-language therapy students indicated that, despite descriptive findings suggesting a slightly greater percentage of improvement in the classroom-based group, statistical analysis did not confirm a significant difference. Since this study was conducted to investigate the effectiveness of the ISD, it adopted the principle of a noninferiority trial, in which a new intervention is considered acceptable if it is not substantially less effective than an established approach within a predetermined margin (National Cancer Institute, n.d.). Based on this perspective, the improvement observed suggests that the ISD has the potential to supplement classroom-based training. While no prior research has examined computer-based dysphagia SLEs using similar clinical measures, the findings of this study are consistent with those of Bartlett, Bruecker, and Eccleston (2020). In their study, speech-language therapy students who received traditional instructional training achieved similar short-term test scores on clinical swallow evaluation as students who underwent additional simulation training using SP. The equivalent outcome of both training groups may be impacted by several factors. Firstly, it is probable that both ways of training included the same fundamental information on the management of dysphagia. When the instructional materials and learning objectives are properly matched, students can attain similar levels of comprehension and achievement, regardless of how the information is presented (Clark & Mayer, 2023; Tallent-Runnels et al., 2006). The reason for this is that properly aligned instructional materials ensure that the content being taught is directly applicable to the learning objectives, which are the specific skills or knowledge that students are expected to acquire.

In addition, both ISD and classroom-based training groups received identical training content and case scenarios. It could be concluded that the ISD training group received the same comprehensive training as the classroom-based training groups. The findings of this study are consistent with previous research comparing computerized SLE with traditional training methods among healthcare providers, which also showed similar enhancements in clinical knowledge or performance following training in both groups (Bearman et al., 2001; Ma et al., 2024; McGrath et al., 2018; Reinhold et al., 2024; Triola et al., 2006). Nevertheless, further comparative studies are needed to

determine whether ISD training yields different outcomes in students' practical skills compared to classroom-based training groups. The ISD training incorporates both cognitive and psychomotor elements, particularly cognitive–motor integration such as sequencing oral motor examinations (OME), interpreting CSE and FEES videos, and making diagnostic decisions, which align with the guided response level of psychomotor learning (Simpson, 1972). Therefore, it is valuable to examine its potential carryover effects on practical performance. This is especially relevant as individual performance can be influenced by learning styles, which may lead to varied outcomes (Hussein Ibrahim & Hussein, 2015). Some students might perform better in practical activities rather than analytical assessment, and vice versa (Sternberg et al., 2008).

Another crucial aspect of learning and training is the delivery of effective feedback mechanisms. Research has demonstrated that feedback is the most effective instructional approach (Hattie & Yates, 2014; Issenberg et al., 2005). The inclusion of feedback in training has been demonstrated to have a favorable impact on learners' results, regardless of whether through human instructor or via simulator itself (Gaba, 2004; Motola et al., 2013; Strandbygaard et al., 2013) . In this study, speech-language therapy students received both training approaches incorporated timely and constructive feedback. This might have had a substantial impact on students' comprehension and rectification of errors, resulting in comparable enhancements in their test scores. While students in the classroom setting received direct feedback from the clinical educator, those using the ISD obtained feedback through indications of correct or incorrect responses, along with some direct informational feedback provided by the system. This suggests that the provision of feedback itself, rather than only the mode of training, may have been the key factor influencing learning outcomes. When learners are aware of the chance to obtain precise and timely feedback, they show a noticeably greater degree of commitment and invested more time and effort into their tasks (Northcraft et al., 2011). In addition, corrective feedback provides learners with guidance on their progress and is particularly beneficial for novice learners while informative feedback assists learners in connecting ideas and concepts, enabling them to advance their understanding (Hattie & Yates, 2014). Thus, it could be inferred that the inclusion of feedback in the training methods has impacted the enhancement of students' understanding of dysphagia management in both groups.

Other than that, although Clark and Mayer (2023) emphasized that method of delivery could be suppressed by instructional material and content, Vygotsky's (1978)

theory of social constructivism highlights the significance of social interaction and a supportive atmosphere for learning in promoting learning. According to Vygotsky's (1978) theory, learning experience should be supported by emphasizing interaction, promoting collaborative learning experiences, in which learners collaborate to solve issues and create meaning. While classroom-based training allows for social interaction, this feature is absent in the ISD. Nevertheless, in a computer-based interactive package like the ISD, various interactive multimedia components, as simple as basic forward arrows and clickable menu bars, will still enhance learner engagement without necessitating the usual behavioral reactions linked to social engagement (Clark & Mayer, 2023). The incorporation of interactive elements in computer-based instruction and the cooperative elements of classroom-based training may exert a comparable influence on student engagement and learning (Clark & Mayer, 2023).

In contrast to the comparable performance findings between both groups, the evaluation of individual percentage improvements and normalized gain scores revealed that two individuals, P3 and P8, in the classroom-based training groups actually obtained negative gain scores in Case B. Both individuals also showed lower percentages of improvement and normalized gain scores in Case A. Interestingly, a closer examination of their pre-test scores indicated that they achieved top scores initially. This is not uncommon because students with high pre-test scores tend to have lower normalized gain scores due to having less room for improvement (Arico et al., 2018; Hake, 1998). Consequently, any minor decrease in score can result in a negative normalized gain. This pattern is evident in the low-level negative normalized gain scores for both individuals (Hake, 1998).

In general, the analysis of normalised gain scores indicated that the speech-language therapy students exhibited relatively low normalised gain scores for both Case A and Case B. Despite students repeatedly answering Case A pre and post-test, the normalised gain score for Case A was not far removed from the normalised gain score in Case B for both groups. These findings contradict prior study that showed an enhancement in students' scores when given the same questions on repeat (Butler, 2010). Hence, the impact of practice transfer or test transfer on this outcome can be eliminated (Calamia et al., 2012; Reeve & Lam, 2007). The possible reason for this finding is that achieving proficiency in dysphagia management is a skill that must be developed via deliberate practice, as demonstrated by past studies (Caesar & Kitila, 2020; Perry, 1999). Moreover, the test involved the interpretation of FEES clips, and it

is known getting interrater agreement on FEES interpretations might be challenging (Colodny, 2002; Pilz et al., 2016). A single-day training session is insufficient for a student or novice SLT to attain full expertise.

Based on a descriptive study of the median scores, both training groups demonstrated percentage increases: the classroom-based training group with 6% increase for Case A and an 8% increase for Case B, while the ISD group showed a 2% increase for Case A and a 5% increase for Case B. Even a slight change in students' percentage is significant and can impact students' grades. For example, at IIUM, the grading scales are as follows: A (85% to 100%), A- (75% to 84%), B+ (70% to 74%), and the scales continue in intervals of 5% down to an F for scores below 35%. This is further supported by Koles et al. (2010), who found a 5.9% increase in mean scores for medical students involved in active team-based learning. This increase is significant enough to have practical value for educators and learners aiming to achieve learning goals (Koles et al., 2010). Given that this study assessed only the overall improvement of application-based knowledge in dysphagia management through pre- and post-test scores, future research would benefit from evaluating specific components of training. Such an approach would enable a more detailed observation of improvements in particular areas, including cranial nerve examinations, FEES interpretation, and other relevant aspects of dysphagia management.

6.4.1.2 Positive Outcomes on Perceived Confidence, Attention, Relevance and Satisfaction from Utilizing the ISD

The analysis of components in IMMS revealed that both types of training provide the equivalent level of confidence, attention, relevance and satisfaction to the respective study participants. This result is consistent with previous studies that explore learners' motivation on virtual simulation training across field of studies including engineering, nursing, education and health sciences using IMMS (Billner-Garcia & Spilker, 2024; Kumar et al., 2023; Low et al., 2022; Yas et al., 2014). 'Attention' here refers to the motivational factors that stimulate and engage learners, hence increasing their curiosity about the subject matter (Low et al., 2022). When learners were exposed to virtual computer-based activities, they actively participated in interactive learning experiences that promoted deep learning (Yas et al., 2014). Incorporating captivating backgrounds,

engaging sounds, and interactive multimedia elements into computer-based activities can heighten learners' emotional arousal and enhance their level of attentiveness (Mayer, 2002). On the other hand, during classroom-based training, students engaged in learning through interaction with the educator that promoted participation and engagement (Khadidja, 2020). These findings explained the underlying cause for the high rating of attention domain in both groups. This premise is further reinforced by favorable response from students regarding the ISD's interactivity and engaging software. One of the statements regarding the ISD is, “Interactive learning tools for the student. It avoids student to feel bored during study.”

The construct 'Confidence' in IMMS refers to the motivational variables that enable learners to feel and believe in their ability to succeed and exert control over their own accomplishment (Low et al., 2022). Students in the ISD group engaged in self-directed learning and were allowed to progress from case to case at their own pace. The ISD provided feedback specific to the learners' responses, whether they chose the correct or incorrect answers. When learners engage in self-directed learning and receive personalized feedback from the software, their confidence is boosted. In addition, students in the classroom-based training group received continuous feedback from the educator on each item during their training. Educators also frequently provided explanations or the rationale behind correct answers. As noted by Low et al. (2022), confidence can be nurtured by offering instructional materials that foster self-growth, coupled with constructive feedback, which encourages learners to complete the course with minimal or no worries. Additionally, using a menu-driven structure, providing summaries, and using language that attributes success to learners' efforts and abilities can enhance their confidence as they progress through the material (Song & Keller, 2001). The ISD has demonstrated its ability to enhance students' confidence in managing dysphagia patients, which was found to be deficient among freshly graduates and novice SLTs in prior studies (Caesar & Kitila, 2020; Mustaffa Kamal et al., 2012b; Singh et al., 2015). This finding aligns with prior research that concludes that the utilization of computerised SLE can help to enhance students' confidence in dysphagia management (Bryan, 2022).

'Relevance' refers to the perceived usefulness of a task or piece of work (Justo et al., 2022). For tasks to be effective, they should align with learners' personal needs and goals (Low et al., 2022). Dysphagia management is a compulsory topic within the speech-language therapy curriculum, so it is unsurprising that all students participating

in this study recognized the relevance of this subject. Other than that, Keller (1987) suggested that to establish relevancy, instructional task should employ examples that are known to the learners (Keller, 1987). An effective approach is to be grounded on students' prior knowledge and abilities, demonstrating how they might deepen their comprehension based on their past encounters (Malik, 2014). Based on demographic information, it was noted that speech-language therapy students had prior exposure to FEES and dysphagia management during their practical sessions. This prior experience suggests that the implementation of CBL for dysphagia management likely enhanced their understanding of the subject, as evidenced by the improvement in their post-test scores in this study.

In the context of IMMS, the term ‘Satisfaction’ refers to the elements that enhance learners' achievements through both extrinsic and intrinsic rewards (Low et al., 2022). Extrinsic and intrinsic rewards should be given to learners in a suitable reinforcement schedule and timeframe to stimulate their motivation to learn (Keller, 2010). Extrinsic rewards encompass grades, opportunities for progress, and documented accomplishments, whereas intrinsic rewards involve feeling that their opinions are valued, boosting self-esteem, and positive interactions with others (Keller, 2010). It can be inferred that both training groups received prompt feedback that effectively achieved a desirable degree of extrinsic and intrinsic reward.

Lastly, the overall score indicates that the level of motivation is comparable for both the ISD training group and the classroom-based training group. This contrasts with several prior studies that have compared classroom-based training methods with computer-based simulations, where a preference for virtual computer-based instruction was observed (Sulong et al., 2020; Yas et al., 2014). Nonetheless, this study suggests that both training approaches can effectively motivate speech-language therapy students in learning dysphagia management. The active learning components (Affoo et al., 2020), and feedback mechanisms present in both methods likely played a significant role in maintaining similar motivation levels in both groups. Moreover, when elements such as attention, relevance, confidence, and satisfaction are thoroughly incorporated into instructional training, there is a concurrent increase in student motivation (Izmirli & Sahin Izmirli, 2015).

6.4.1.3 The Usability of the ISD

The present study also aimed to examine the usability of the ISD. Usability here refers to the extent to which a user can effectively, efficiently, and satisfactorily use a system to achieve a specific objective (Junus et al., 2015). The result of SUS scores revealed that all participants agreed that the ISD has good usability. This finding aligns with another investigation by Birrenbach et al. (2023), in which the SUS was employed to assess the usability of a recently developed VR simulation training program for medical purposes. However, when assessing a novel instructional training, it is important to consider that the evaluation may be influenced by the novelty effect, leading to potentially inflated measurements of usability (Huang et al., 2020). To further investigate any concerns regarding the newly generated computer-based instructions, open-ended queries can be employed (Ssemugabi & De Villiers, 2010).

By evaluating the negative aspects and recommendations provided by the students, concerns regarding the ISD were identified. The negative feedback primarily centered around technical issues, such as slow loading times and the length of time allocated for feedback. Despite these challenges, it appears that these factors had a minimal impact on the overall performance of the ISD. Moving forward, addressing these technical issues and optimizing the feedback duration in response to user input will be essential for improving the ISD's effectiveness and enhancing the overall user experience

6.4.2 Feedback on the ISD

Furthermore, beyond the primary objectives, the feedback from speech-language therapy students on the ISD was examined. Overall, students reported a positive experience with the content, flow, and multimedia elements of the ISD. The most anticipated feature was the utilization of various feedback mechanisms, which students found beneficial. Future research is necessary to verify whether the quantity of feedback given can impact the relevance of the content in the ISD.

Additionally, the use of SP images, videos, and clinical backgrounds in the ISD contributed to a heightened sense of realism for the students. This finding aligns with the previous study by Bryan (2022), which reported similar responses from speech-

language therapy students during dysphagia management and VFSS interpretation training using computer-based SLE. Realism is one critical aspect of SLE (Gaba, 2004). The incorporation of realism in SLE enables users to engage in a meaningful and applicable way (Lioce et al., 2015).

However, following this study, the ISD underwent further evaluation in collaboration with experts, and several limitations related to both technical and content aspects were identified. As discussed in Sections 6.3.6 and 6.3.7, issues such as multimedia processing delays and occasional software bugs were noted, which may affect the user experience. This is consistent with the observations of Cook et al. (2011), who emphasized that the pacing of simulations should allow learners sufficient time to process information for effective learning. In the context of this study, this highlights the importance of providing feedback of adequate duration within the simulation, as timely yet unhurried feedback enables learners to consolidate their understanding and apply knowledge more effectively to clinical scenarios. In addition, improvements to the ISD content are essential to ensure that the information presented to students is accurate and pedagogically sound.

6.5 CHAPTER SUMMARY

The current study assessed the effectiveness of the newly developed ISD by comparing it with classroom-based training methods and the usability of the ISD. Both training groups demonstrated improvement post-training, with speech-language therapy students showing comparable results in application-based knowledge of dysphagia management. The IMMS, which was employed to assess motivational differences between the two instructional methods, revealed that both training groups scored equivalently. Additionally, students rated the ISD positively in terms of usability, though further improvements are needed to address the technical aspects and content aspects of the ISD. Overall, the ISD demonstrated promising potential as a self-directed learning module to enhance application-based knowledge, supplementing existing teaching and learning approaches.

CHAPTER SEVEN

SUMMARY, IMPLICATIONS, LIMITATIONS, AND RECOMMENDATIONS

7.1 INTRODUCTION

This chapter begins by summarizing the findings of the study. Following this, the implications of the study are discussed, and the chapter concludes with an examination of the study's limitations and recommendations for future research.

7.2 SUMMARY

In Chapters 1 and 2, the background and existing gaps that shaped the objectives of this study were outlined. Over the years, challenges in dysphagia training have been reported, including issues with students' proficiency and confidence in clinical practice. To address these issues, Simulated Learning Environments (SLEs) have been adopted as an educational approach aimed at enhancing learning outcomes and experiences. While SLEs are increasingly utilized in medical and health sciences training, their application in speech-language therapy remains relatively new, especially in the area of dysphagia management. Drawing from the literature review and the identified limitations and gaps in prior research, the research objectives and hypotheses are presented in Chapter 3.

Following the ADDIE model, a needs analysis was conducted with aim of developing an interactive self-training system for dysphagia management (the ISD) tailored to Malaysian SLT practice. A survey was created and distributed to identify clinical incompetencies among speech-language therapy students during their clinical training. The process of development and the survey results are detailed in Chapter 4. The survey findings indicated that the most frequent areas of incompetency were related to FEES, as well as management and planning. Further analysis indicated that students struggled with reasoning skills and faced challenges in integrating their theoretical knowledge into clinical practice. This finding is further supported by the thematic

analysis of open-ended survey questions, where clinical educators highlighted that the primary challenges in dysphagia training were related to the students' grasp of theoretical knowledge and their ability to apply this knowledge in clinical settings. These challenges were encapsulated in the theme "challenges related to students." Additionally, under the theme "challenges related to the clinical environment," clinical educators reported difficulties in providing students with adequate opportunities to work with dysphagia patients and to conduct instrumental assessments. Therefore, if SLE were to be implemented in dysphagia teaching, clinical educators suggested that it should focus on strengthening theoretical knowledge and enhancing reasoning skills. They also recommended that the SLE be designed to increase practice frequency and enrich the learning experience, particularly for novice learners.

By integrating insights from the literature review on SLE and findings from the survey, the ISD was designed and developed as presented in Chapter 5. The ISD was created using the CBL approach, with a primary focus on CSE and FEES interpretations. Based on the results of the assessments, students were directed to determine potential diagnoses and suggest appropriate interventions. During the development phase, the content of the ISD was validated by the experts. The ISD was also tested during the implementation phase to ensure its readiness.

In Chapter 6, a pretest-posttest quasi-experimental study was conducted to evaluate the effectiveness of the ISD. The results indicated that students who underwent classroom-based training and those who trained with the ISD demonstrated comparable improvements in their application-based knowledge of dysphagia management. Therefore, the alternative hypotheses were accepted. Additionally, the motivational impact of the ISD was observed, with equivalent results for both groups. Overall, feedback on the use of the ISD was positive; however, further refinements are needed to enhance certain technical features and content.

7.3 IMPLICATION OF THE STUDY

This research has several significant and noteworthy implications. Detailed explanations of the implications are provided below.

The first implication is regarding the survey in identifying clinical incompetencies among speech-language therapy students and the challenges during

dysphagia training. The identification of clinical incompetencies and the fundamental challenges encountered by students enables clinical educators to gain a greater understanding of the precise areas in which students have difficulty, especially in complex topic such as FEES interpretations. This insight allows for the development of targeted interventions and training modules that address these challenges directly, potentially leading to improved educational outcomes and better preparation of students for practical clinical environments. Moreover, understanding these challenges can guide the development of educational programs, ensuring that theoretical knowledge is successfully applied to practical skills, so improving the standard of treatment delivered by future SLTs.

Secondly, the development and implementation of the ISD as a self-training interactive system for dysphagia management carry important clinical implications for speech-language therapy education and training. To enhance the overall competence of students, the ISD offers a structured and interactive learning environment. It engages learners in case-based scenarios that require them to apply theoretical knowledge to clinical practice, thereby strengthening their application-based knowledge. This process is further supported by the various feedback mechanisms embedded within the ISD.

Moreover, the ISD provides a safe and controlled environment for students to practice and refine their skills without the risk of causing harm to actual patients. By allowing repeated practice and immediate feedback, the ISD helps to address common areas of difficulty, ultimately leading to improved students' clinical performance and patient outcomes.

In addition, the ISD's use of multimedia elements, such as videos, SP images, and clinical background settings, enhances the realism of the simulation, further supporting the development of practical skills that are potentially transferable to clinical practice. This aligns with the essential aspects of SLE as outlined by Gaba (2004), where realism and engagement are crucial for effective learning.

As a digital tool, the ISD can be easily integrated into SLT curricula, providing consistent training experiences regardless of geographic location or the availability of clinical educators. This standardization ensures that all students receive the same level of preparation, thereby raising the overall quality of dysphagia care provided by future SLTs. Besides, the implementation of the ISD has the potential to be economically efficient, thereby minimizing the requirement for substantial amount of physical resources and challenges related to clinical placement.

7.4 STUDY LIMITATIONS

The current study, while offering valuable insights into the potential of the ISD as a training tool for speech-language therapy students, is not without its limitations. The first limitation relates to the needs analysis phase. In this study, the survey was conducted only with clinical educators. Future research could broaden the data sources to include input from students and academic staff, thereby providing a more comprehensive perspective. In addition, while the survey explored clinical educators' perceptions of the challenges in dysphagia training, it did not capture their views on the strengths of current educational methods. Gathering such information in future studies would provide a more balanced understanding of both the challenges and effective practices in dysphagia education.

The ISD was tested on only 10 SLT students from a single university. This limits the generalizability of the findings, as the results may not accurately reflect the broader population of SLT students across different institutions. Perhaps, the ISD effectiveness can be tested on speech-language therapy students from different educational backgrounds and learning experiences.

Another limitation of the study is that the pre- and post-tests used to measure the effectiveness of the ISD were based solely on application-based test rather than practical skills assessments. Therefore, the conclusion is limited by the study design that focused on cognitive domain of psychomotor abilities only. While knowledge acquisition is an important component of SLT training, the practical application of this knowledge in clinical settings is crucial for effective dysphagia management. The reliance on application-based exams may not fully capture the students' ability to translate theoretical knowledge into clinical practice, particularly in areas that require hands-on skills, such as OME.

Lastly, the effectiveness of the ISD training only included improvement on immediate post-test results. Therefore, it only provides insight into the short-term impact of the ISD but they do not account for how well students retain and apply this knowledge in real-world clinical situations over time. Without longitudinal data, it is difficult to determine the sustained effectiveness of the ISD as a training tool.

7.5 FUTURE RECOMMENDATIONS

To address these limitations and enhance the applicability of the findings, future research should consider several key recommendations. Firstly, it is essential to conduct studies in more diverse sample sizes that include speech-language therapy students from multiple universities. This would provide a more comprehensive understanding of the ISD's effectiveness across different populations and help identify any variations in its impact based on factors such as prior experience or learning styles.

Secondly, future studies should incorporate practical skills assessments alongside application-based exams to evaluate the full spectrum of student learning outcomes. By including objective measures of students' ability to perform dysphagia assessment tasks, such as OME and food and water trials, researchers can gain a more accurate understanding of how well the ISD prepares students for real-world clinical practice.

In addition, it is recommended that future research include long-term follow-up assessments to evaluate the retention of knowledge and skills over time. This would provide valuable insights into the lasting impact of the ISD and its effectiveness in preparing students for sustained clinical competence in dysphagia management. Other than that, the progress of students' achievement in each case of the ISD could also be evaluated to observe any improvement over time or across different types of cases.

Lastly, expanding the scope of the ISD to include a wider range of clinical scenarios and integrating feedback from practicing clinicians could further enhance its educational value. In conclusion, while the initial findings of this study are promising, further research with more diverse samples and comprehensive assessment methods is necessary to fully understand the potential of the ISD as a tool for dysphagia training. By addressing these limitations and building on the current study's findings, future research can contribute to the ongoing improvement of speech-language therapy education and ultimately enhance the quality of care provided to individuals with dysphagia.

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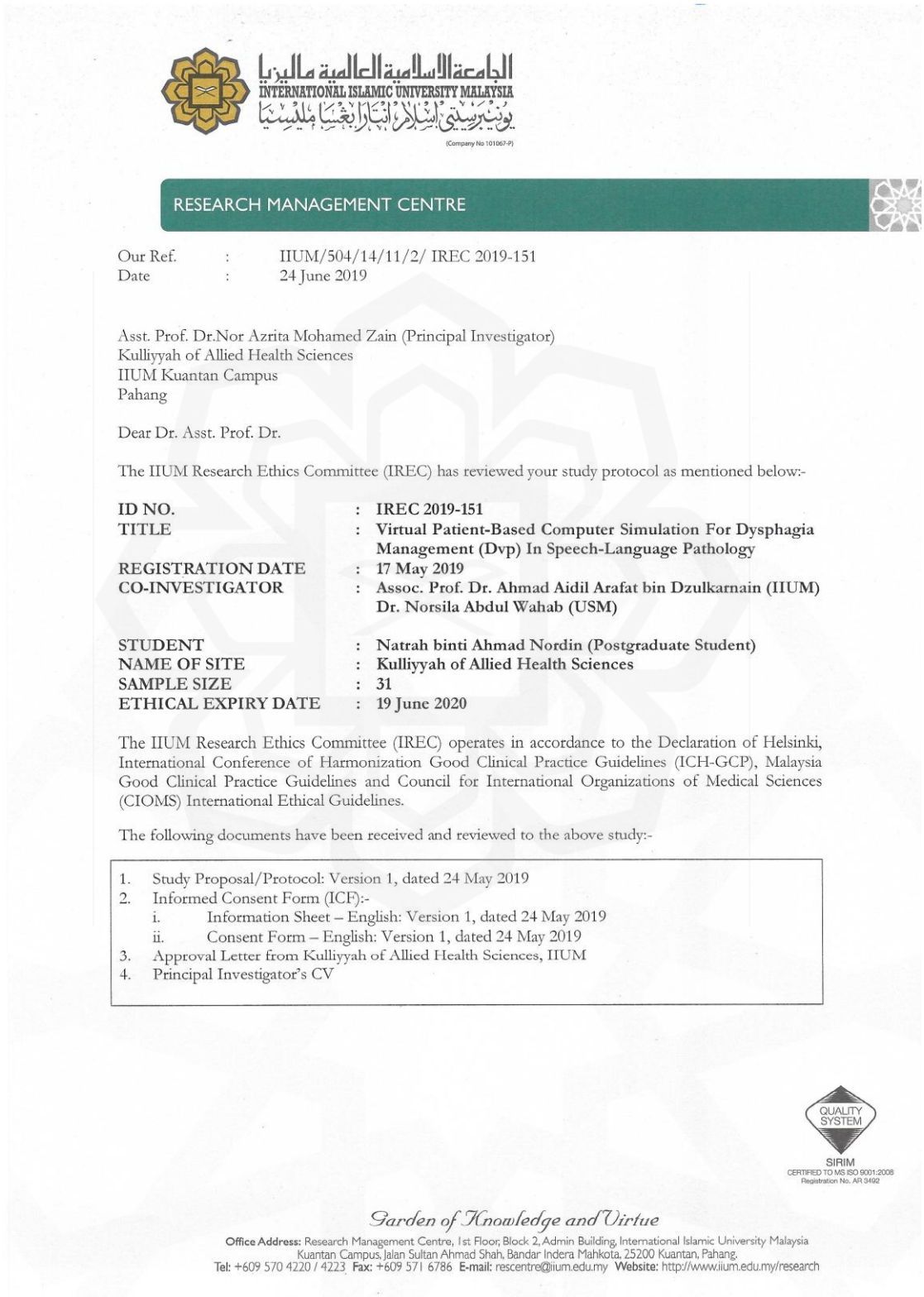
APPENDICES

APPENDIX A: IREC APPROVAL FORM



الجامعة الإسلامية العالمية ماليزيا
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA
(Company No 101067-P)

RESEARCH MANAGEMENT CENTRE

Our Ref. : IIUM/504/14/11/2/ IREC 2019-151
Date : 24 June 2019

Asst. Prof. Dr.Nor Azrita Mohamed Zain (Principal Investigator)
Kulliyyah of Allied Health Sciences
IIUM Kuantan Campus
Pahang

Dear Dr. Asst. Prof. Dr.

The IIUM Research Ethics Committee (IREC) has reviewed your study protocol as mentioned below:-

ID NO.	:	**IREC 2019-151**
TITLE	:	**Virtual Patient-Based Computer Simulation For Dysphagia Management (Dvp) In Speech-Language Pathology**
REGISTRATION DATE	:	**17 May 2019**
CO-INVESTIGATOR	:	**Assoc. Prof. Dr. Ahmad Aidil Arafat bin Dzulkarnain (IIUM) Dr. Norsila Abdul Wahab (USM)**
STUDENT	:	**Natrah binti Ahmad Nordin (Postgraduate Student)**
NAME OF SITE	:	**Kulliyyah of Allied Health Sciences**
SAMPLE SIZE	:	**31**
ETHICAL EXPIRY DATE	:	**19 June 2020**

The IIUM Research Ethics Committee (IREC) operates in accordance to the Declaration of Helsinki, International Conference of Harmonization Good Clinical Practice Guidelines (ICH-GCP), Malaysia Good Clinical Practice Guidelines and Council for International Organizations of Medical Sciences (CIOMS) International Ethical Guidelines.

The following documents have been received and reviewed to the above study:-

1. Study Proposal/Protocol: Version 1, dated 24 May 2019
2. Informed Consent Form (ICF):-
   i. Information Sheet – English: Version 1, dated 24 May 2019
   ii. Consent Form – English: Version 1, dated 24 May 2019
3. Approval Letter from Kulliyyah of Allied Health Sciences, IIUM
4. Principal Investigator's CV

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Office Address: Research Management Centre, 1st Floor, Block 2, Admin Building, International Islamic University Malaysia
Kuantan Campus, Jalan Sultan Ahmad Shah, Bandar Indera Mahkota, 25200 Kuantan, Pahang.
Tel: +609 570 4220 / 4223 **Fax:** +609 571 6786 **E-mail:** rescentre@iium.edu.my **Website:** http://www.iium.edu.my/research

Decision by IIUM Research Ethics Committee (IREC):

(√) Approved
( ) Disapproved

Date of Approval: **19 June 2019**

The investigator(s) are required to:

a) submit the 'Continuing Review Form' 30 days before **EXPIRY DATE** to renew Ethical Approval.
b) notify IREC of any change in protocol and obtaining further ethical approval as appropriate.
c) report any adverse incident during the course of a study to IREC even if the incident is not directly related to the study.
d) report to the IREC within 72 hours for all internal SAEs (occurring in IIUM PI site).
e) report in a prompt manner if the information impacts the continued ethical acceptability of the trial for external SAEs (occurring in participants at other sites).
f) provide information of minor protocol deviation in Progress Report or End Report whichever necessary.
g) report any major protocol deviation occurs within 5 working days.
h) submit Progress Report Form before the end of six (6) month given by IREC.
i) complete and submit the End of Project Report Form to the IREC Secretariat's Office.
j) All records and data subjects are **CONFIDENTIAL** and used only for the purposes of this study and all issues and procedures on data confidentiality must be observed.

Thank you.

Yours sincerely,

PROF. DR. NASSER MUHAMMAD AMJAD
Chairman,
IIUM Research Ethics Committee (IREC)

Copy : *File –IREC 2019-151*

DISCLAIMER: The approval letter only covers the ethical aspect of your study only. Any other permission/approval to use any facilities, data or human resource should fall under applicant's responsibility.

APPENDIX B: INITIAL SURVEY

IDENTIFICATION OF CLINICAL INCOMPETENCIES AMONG SLT STUDENTS DURING DYSPHAGIA TRAINING AND SURVEY ON SIMULATED LEARNING ENVIRONMENT (SLE) AMONG CLINICAL EDUCATORS.

SECTION A: Demographic Information

INSTRUCTION: Please fill/tick in the information that is related to you.

Years of Experience

Age	[ ] < 25 years old
	[ ] 25 to 35 years old
	[ ] 36 to 45 years old
	[ ] more than 45 years old
Education	[ ] Bachelor's degree
	[ ] Master's degree
	[ ] PhD
Working experience	[ ] 5 to 10 years
	[ ] 11 to 15 years
	[ ] >15 years
Supervising Experience	[ ] 1 to 5 years
	[ ] 5 to 10 years
	[ ] >10 years
Institution	[ ] University
	[ ] Government hospital
	[ ] Private practice

SECTION B: Identified Clinical Incompetencies among Speech-Language Therapy Students During Dysphagia Training

INSTRUCTION: Below are the common types of incompetencies among speech-language therapy students during their dysphagia clinical training. Please read the statements carefully and rate the occurrence based on the following:

NOT AT ALL

RARELY

OCCASIONALLY

FREQUENTLY

At the end of every section, you may add other types of incompetencies that you may think relevant but not included in this survey.

ITEM	RATE			
CASE HISTORY	Not at all	Rarely	Occasionally	Frequently
1. Unable to conduct a comprehensive history taking.				
2. Unable to use simple and clear questions.				
3. Using jargons and medical terms with the patient.				
4. Unable to rephrase questions when patient find it difficult to understand.				
5. Unable to probe for details and further data/ facts from patient's given information.				
6. Others: _____ _____				
ORAL MOTOR EXAMINATION	Not at all	Rarely	Occasionally	Frequently
1. Demonstrate wrong technique when examining the patient.				
2. Unable to provide correct/proper instructions to the patient.				
3. Unable to relate the findings with cranial nerve functions.				
4. Incorrect placement of utensil (eg tongue depressor).				
5. Unable to relate the findings to determine type of instrumental assessment to be conducted.				
6. Others: _____ _____				
CERVICAL AUSCULTATION	Not at all	Rarely	Occasionally	Frequently

1. Unable to palpate the correct structures.				
2. Unable to differentiate normal or abnormal hyolaryngeal excursion.				
3. Incorrect placement of the stethoscope				
4. Unable to listen to swallow sounds using stethoscope.				
5. Unable to relate findings from the observation to a possible diagnosis.				
6. Others: _____ _____				
WATER AND FOOD TEST	Not at all	Rarely	Occasionally	Frequently
1. Unable to decide which consistency to be tested with the patient.				
2. Unable to handle patient with sufficient care to ensure safety.				
3. Unable to differentiate types of food/drink consistencies.				
4. Unable to prepare the exact drink/food consistencies using food thickener.				
5. Unable to decide if patient passed or failed the test.				
6. Others: _____ _____				
FIBERENDOSCOPIC EXAMINATION OF SWALLOWING (FEES)	Not at all	Rarely	Occasionally	Frequently
1. Unable to provide correct/proper instructions to the patient.				
2. Unable to relate the findings with cranial nerve functions.				

3. Unable to identify the correct anatomical structures.				
4. Unable to interpret the findings from the observation.				
5. Others: _____ _____				
MANAGEMENT AND PLAN	Not at all	Rarely	Occasionally	Frequently
1. Unable to integrate the results of all the assessment conducted.				
2. Unable to interpret the findings to determine a correct diagnosis.				
3. Unable to use the findings to determine a proper plan for the patient.				
4. Unable to explain the result to the patient.				
5. Unable to use layman terms when explaining results to the patient.				
6. Unable to recommend referrals to other professionals.				
7. Others: _____ _____				
CASE NOTE	Not at all	Rarely	Occasionally	Frequently
1. Unable to come with correct impression or differential diagnosis.				
2. Unable to write clear and correct notes.				
3. Unable to write comprehensive notes.				
4. Others: _____ _____				

PROFESSIONALISM	Not at all	Rarely	Occasionally	Frequently
1. Patient was not greeted when entering the room.				
2. Unable to maintain good manner with the patient.				
3. Unable to conduct assessment in appropriate sequences.				
4. Unable to maintain hygiene when dealing with patient.				
5. Unable to provide consultation using layman terms.				
6. Unable to maintain a comfortable distance from patient.				
7. Unable to appear confident during assessment and result delivery.				
8. Taking inappropriate time (e.g., too much time or too fast) during assessment.				
9. Others: _____ _____				

SECTION C: Opinion on SLT Students' Challenge during Dysphagia Clinical Training and Simulated Learning Environment (SLE).

INSTRUCTION: Below are some questions about your opinion relating to the challenges faced by SLT students during dysphagia clinical training and the SLE.

1. What are the challenges faced by your students during dysphagia training?

_____

_____

_____

2. From (1), which is the most difficult challenge faced by your students?

_____

_____

_____

3. What would be your recommended solution(s) to the above challenge(s)?

_____

_____

_____

4. How does the method of your teaching change over the year, if any?

_____

_____

_____

SLE is a setting of learning that imitates real practice but in controlled environment. Examples of SLE are the usage of mannequin, computer-assisted devices or simulated patients.

5. Are you familiar with Simulated Learning Environment (SLE)? Yes / No

6. What would be the positive aspects if SLE is to be applied in dysphagia teaching?

_____

_____

_____

7. What would be negative aspects if SLE is to be applied in dysphagia teaching?

_____

_____

_____

8. Which component of dysphagia assessment and intervention will be most suitable to be incorporated using SLE?

_____

_____

_____

One of the most common practices in speech-therapy clinical training is the application of case-based training or assessment on standardized patients hired during clinical exams or OSCE.

9. Please share your opinion(s) if case-based training was to be applied virtually instead of using real patients (e.g., using computerized system and software).

_____

_____

_____

10. Do you think it is necessary for the users to be given feedback when utilizing SLE? If yes, what kind of feedback should be provided?

_____

_____

_____

THANK YOU FOR YOUR TIME COMPLETING THIS SURVEY.

APPENDIX C: HARMONISED SURVEY

IDENTIFICATION OF CLINICAL INCOMPETENCIES AMONG SLT STUDENTS DURING DYSPHAGIA TRAINING AND SURVEY ON SIMULATED LEARNING ENVIRONMENT (SLE) AMONG CLINICAL EDUCATORS.

Thank you for your interest to join this study. Please read all information on this sheet.

Purpose of the Study

The current Ph.D. work aims to develop an interactive self-training system for dysphagia management (henceforth ISD). Therefore, we would like to gather information from experienced speech-language therapists' (SLT) regarding common clinical incompetencies among speech-language therapy students and the challenges faced by them during undergraduate dysphagia training in Malaysia. We are also interested to get your opinion on virtual learning dysphagia training.

Who is suitable to participate in this study? This study welcomes SLT:

1. with a minimum of five years working experience AND
2. may have undergone specialized dysphagia training OR
3. had been seeing dysphagia patients for the past five years of practicing AND
4. experienced in supervising speech-language therapy students in managing dysphagia cases at least for one year.

What will happen?

If you choose to participate, you will be asked to complete an online survey. It will only take about 10-15 minutes to complete.

What are the risks and benefits?

There are no identified risks associated with participating in this survey. Your participation in this study is voluntary and there is no financial compensation for participating. However, the benefit of participating in this study is that the information gathered from this project will be compiled and used for the benefit of speech-language therapy students' future training on dysphagia.

What are your rights?

Your personal information and identity will be kept confidential and will not be disclosed

unless required by law or have the consent from you first. Data and information gathered will be stored and analyzed in a password-protected computer. This data will be used in the production and presentation of the academic research. Moreover, a soft copy of the anonymized data may be preserved and where appropriate, used as teaching materials.

If you have any questions, concerns, or reports regarding your rights as a research subject, please contact;

Researcher:

Natrah Ahmad Nordin

Speech-Language Therapy Ph.D. student

natrah@iium.edu.my

012-2011046

Supervisor:

Assistant Prof. Dr. Nor Azrita Mohamed Zain

znazrita@iium.edu.my

09-5706400 Ext: 3318

Thank you for your time reading this project information sheet and considering taking part in the study.

Participants' consent form

By clicking this page, I am certifying on the matter below:

1. I voluntarily agree to be part of this study and willingly to provide the information required

2. I may freely choose to stop being part of this study at any point of time.

3. I have received and understand the information regarding this study, including the risk (if any) of the research.

4. Withdrawal is no longer possible once I have submitted my responses due to the anonymous nature of online surveying.

SECTION A: Demographic Information

INSTRUCTION: Please fill/tick the information that is related to you.

Age	_____
Education	[ ] Bachelor's degree [ ] Master's degree [ ] PhD
Working experience	[ ] 5 to 10 years [ ] 11 to 15 years [ ] >15 years
Supervising Experience	[ ] 1 to 5 years [ ] 5 to 10 years [ ] >10 years
Institution	[ ] University [ ] Government hospital [ ] Private practice [ ] Others:_____
Number of hours spent on Fiberoptic Endoscopic Evaluation of Swallowing (FEES) training (one semester)	_____
FEES interpretation is taught to:	[ ] Year 3 students [ ] Year 4 students [ ] _____

SECTION B: Identified Clinical Incompetencies among Speech-Language Therapy Students During Dysphagia Training

INSTRUCTION: Below are the common types of clinical incompetencies among speech-language therapy students during their dysphagia clinical training. Please read the statements carefully and rate the occurrence based on the following:

NOT AT ALL

RARELY

OCCASIONALLY

FREQUENTLY

At the end of every section, you may add other types of incompetencies that you may think relevant but not included in this survey.

ITEM	RATE			
CASE HISTORY	Not at all	Rarely	Occasionally	Frequently
1. Unable to conduct a comprehensive history taking.				
2. Unable to use simple and clear questions.				
3. Using jargons and medical terms with the patient and/or caregivers.				
4. Unable to rephrase questions when patients and/or caregivers find it difficult to understand.				
5. Unable to probe for details and further data/ facts from patient's given information.				
6. Others: _____ _____				
ORAL MOTOR EXAMINATION	Not at all	Rarely	Occasionally	Frequently
1. Demonstrate wrong technique when examining the patient.				
2. Unable to give correct/appropriate instructions to the patient.				
3. Unable to relate the findings with cranial nerve functions.				
4. Incorrect placement of utensil (e.g., use of tongue depressor).				
5. Unable to relate the findings to determine the type of instrumental assessment to be conducted.				
6. Others: _____ _____				

CERVICAL AUSCULTATION AND HYOLARYNGEAL EXCURSION	Not at all	Rarely	Occasionally	Frequently
1. Unable to palpate the correct structures.				
2. Unable to differentiate normal or abnormal hyolaryngeal excursion.				
3. Incorrect placement of the stethoscope				
4. Unable to listen to swallow sounds using a stethoscope.				
5. Unable to relate findings from the observation to a possible diagnosis.				
6. Others: _____ _____				
WATER AND FOOD TEST	Not at all	Rarely	Occasionally	Frequently
1. Unable to decide which consistency to be prioritized when testing with the patient.				
2. Unable to handle patients with sufficient care to ensure safety.				
3. Unable to differentiate types of food/drink consistencies.				
4. Unable to prepare the exact drink/food consistencies using food thickener.				
5. Unable to decide if a patient passed or failed the test in relation to OME findings.				
6. Unable to decide indication for instrumental assessment.				
7. Others: _____ _____				

FIBERENDOSCOPIC EXAMINATION OF SWALLOWING (FEES)	Not at all	Rarely	Occasionally	Frequently
1. Unable to provide correct/appropriate instructions to the patient.				
2. Unable to relate the findings with cranial nerve functions.				
3. Unable to identify the correct anatomical structures.				
4. Unable to interpret the findings from the observation.				
5. Unable to give feedback to patient and/or caregivers				
5. Others: _____ _____				
MANAGEMENT AND PLAN	Not at all	Rarely	Occasionally	Frequently
1. Unable to integrate the results of all the assessment conducted.				
2. Unable to interpret the findings to determine a correct diagnosis.				
3. Unable to use the findings to determine a comprehensive plan for the patient.				
4. Unable to explain the result to the patient.				
5. Unable to use layman terms when explaining results to the patient.				
6. Unable to recommend referrals to other professionals if necessary.				
7. Others: _____ _____				
CASE NOTE	Not at all	Rarely	Occasionally	Frequently

1. Unable to come with correct impression or differential diagnosis.				
2. Unable to write correct notes.				
3. Unable to write clear notes.				
4. Unable to write comprehensive notes.				
5. Others: _____ _____				
PROFESSIONALISM	Not at all	Rarely	Occasionally	Frequently
1. Patient was not greeted when entering the room.				
2. Unable to maintain good manners with the patient.				
3. Unable to conduct assessment in appropriate sequences.				
4. Unable to maintain hygiene when dealing with patients.				
5. Unable to provide consultation using layman terms.				
6. Unable to maintain a comfortable distance from patient.				
7. Unable to appear confident during assessment and result delivery.				
8. Taking inappropriate time (e.g., too much time or too fast) during assessment.				
9. Others: _____ _____				

SECTION C: Opinion on SLT Students' Challenge during Dysphagia Clinical Training .

INSTRUCTION: Below are some questions relating to the challenges faced by SLT students during dysphagia clinical training and the SLE.

1. List down the challenges faced by your students during dysphagia training.

_____

_____

_____

2. From (1), which is the most difficult challenge faced by your students?

_____

_____

_____

3. What would be your recommended solution(s) to the above challenge(s)?

_____

_____

_____

SECTION D: Opinion on teaching using Simulated Learning Environment (SLE)

1. Has your method of teaching changed over the years?

[ ] Yes
[ ] No

2. If (1) Yes, how does the method of your teaching change?

_____

_____

_____

Simulated Learning Environment (SLE)

SLE is a setting of learning that imitates real practice but in controlled environment. Examples of SLE are the usage of mannequin, computer-assisted devices or simulated patients.

3. Have you heard about Simulated Learning Environment (SLE) before?

[ ] Yes
[ ] No

4. Have you used SLE in dysphagia teaching?

[ ] Yes
[ ] No

5. What would be the positive aspects if SLE is to be applied in dysphagia teaching?

_____
_____
_____

6. What would be negative aspects if SLE is to be applied in dysphagia teaching?

_____
_____
_____

7. Which component of dysphagia assessment and intervention will be most suitable to be incorporated using SLE?

_____
_____
_____

One of the most common practices in speech-pathology clinical training is the application of case-based training or assessment on standardized patients hired during clinical exams or OSCE.

8. Please share your opinion(s) if case-based training was to be applied virtually instead of using real patients (eg using computerized system and software).

_____
_____
_____

9. Do you think it is necessary for the users to be given feedback when utilizing SLE? If yes, what kind of feedback should be provided?

_____

_____

_____

THANK YOU FOR YOUR TIME COMPLETING THIS SURVEY.

APPENDIX D: EXPERT VALIDATION FORM I (EXAMPLE)

THE ISD CASES VALIDATION FORM

Case 1: Mrs Norma (Normal swallowing)

INSTRUCTIONS: Below is **one (1)** normal swallowing case that was created for the development of interactive self-training system for dysphagia management (the ISD) for speech-language pathology students. While referring to Case 1 in the ISD software prototype, kindly rate the statement in the columns below using the scale of 1 (not relevant), 2 (somewhat relevant), 3 (quite relevant), 4 (highly relevant). There are **three (3)** short FEES clips to be observed in Case 1. You may also provide your suggestions/comments in the final column.

Remarks:
NAD: No abnormalities detected WNL: within normal limit

No	Item	Information	Relevance				Suggestions/Comments
			1	2	3	4	
i.	**Patient's Information**	**Mrs Norma** Female / 43y / Married / Engineer Height: 170 cm Weight: 68 kg BMI: 28.3 kg/m^2 Background: Referred by medical department. Case of multifocal infarct CVA, 2/12 ago. Discharged from the hospital 1/12 with NG tube feeding. Patient took off his NG tube and been on oral feeding since 3 days ago.					

		No cough or shortness of breath. No fever. Complaint: Patient claimed had no problem with oral feeding. Date for swallowing evaluation and FEES: 1/12 after discharged.					
[A]	**General observation**						
i.	*Patient's position.* Identify which position is suitable for swallowing assessment. If lying*:*	Position A (30° to 45°)					
	[Image position A]						
	[Image position B]						
	Pop-up feedback for wrong answer	Please ensure patient's safety!					
	Identify which position is suitable for swallowing assessment. If lying*:*	Position A (90°)					
	[Image position A]						
	[Image position B]						

	Pop-up feedback for wrong answer	Patient should be at 90°!					
[B]	**Oral Motor Examination (OME)**						
i.	*Face, lips, and jaw*						
	[Image]						
	Is the face symmetrical?	Yes					
	[Image]						
	Can the patient pucker her lips?	WNL					
	[Image]						
	Can the patient retract her lips?	WNL					
	Pop-up feedback on correct answer	During trial swallows, observe anterior spillage, which is indication of muscle weakness!					
	[Image]						
	Observe mouth closure at rest.	WNL					
	[Image]						
	Can the patient open her mouth?	Yes					
	[Image]						
	Limited movement?	No					
	[Image]						
	Can the patient open her mouth against resistance?	Yes					
ii.	*Oral cavity*						
	[Image]						
	Any missing teeth? Observe the dentition.	WNL					
	Observe the oral hygiene.	WNL					
		Poor oral hygiene leads to increased incidence of aspiration pneumonia.					

iii.	*Tongue*						
	[Image]						
	How is the tongue at rest?	NAD					
	[Image]						
	Can the patient protrude her tongue?	WNL					
	[Image]						
	Can the patient touch her upper lips with the tip of her tongue.	WNL					
	[Image]						
	Can the patient move her tongue to the left.	WNL					
	[Image]						
	Can the patient move her tongue to the right.	WNL					
	[Image]						
	Can the patient move her tongue from side to side.	WNL					
iv.	*Palate*						
	[Image]						
	Observe the uvula movement. Movement:	WNL					
	[Sound box]						
	Listen to the voice quality	WNL					
v.	*OME Results* *What can you conclude on the cranial nerves function?*						
	Trigeminal nerve	Intact					
	Facial nerve	Intact					
	Glossopharyngeal nerve	Intact					
	Vagus nerve	Intact					

	Accessory nerve	Intact					
	Hypoglossal nerve	Intact					
[C]	**Hyolaryngeal excursion and cervical auscultation**						
i.	*Hyolaryngeal Excursion* Hyolaryngeal excursion (HE) is often assessed through palpation during clinical swallowing examination (CSE).						
	[Image]						
	Cervical Auscultation Cervical Auscultation (CA) is a technique used to listen and assess swallow sounds during CSE.						
	[Image]						
[D]	**Food and Water Test**						
i.	*Dry swallow* Prior to food and water testing, observe the patients' ability to swallow her saliva. Observe hyolaryngeal excursion, spontaneous throat clearing, and/or coughing.						

	Click image to listen to an example of normal swallow sound.						
	[Swallow sound]						
	[Videos : liquid consistencies]						
ii.	Which volume and consistency would you proceed with, first?	A. Teaspoon (5ml) B. Thin liquid					
iii.	*Thin liquid (Teaspoon, 5 ml)*						

	Instruction to the patient: "Now I am going to give you a spoon of water. Just swallow like usual when you are ready." Laryngeal displacement observation: Appeared good, adequate for a swallow.						
	Listen carefully. What did you hear?	Single swallow sound					
	Spontaneous cough?	No					
	Spontaneous throat clearing?	No					
	Another sip?	Yes					
	Pop-up feedback	Repeat at least three sips!					
	Second trial	Single swallow sound, no cough, no throat clearing					
	Third trial	Single swallow sound, no cough, no throat clearing					
	Will you upgrade utensil/increase volume?	Yes					
	Pop-up feedback	Proceed with 10 ml of water!					
iv.	*Thin liquid (Tablespoon, 10 ml)* Instruction to the patient, "Now I am going to give you more water. Just swallow like usual when you are ready." Laryngeal displacement observation: Appeared good, adequate for a swallow.						
	Listen carefully. What did you hear?	Single swallow sound					
	Spontaneous cough?	No					

	Spontaneous throat clearing?	No					
	Another sip?	Yes					
	Pop-up feedback	Repeat at least three sips!					
	Second trial	Single swallow, no cough, no throat clearing					
	Third trial	Single swallow, no cough, no throat clearing					
	Will you upgrade utensil/increase volume?	Yes					
v.	*Thin liquid (Cup, 90 ml)* Instruction to the patient: "Next, I am going to give you a cup of water. Hold it with your hand and drink as usual."						
	Spontaneous cough?	No					
	Spontaneous throat clearing?	No					
vi.	Which consistency(ies) would you proceed now?						
	None	-					
	Ice-chips	Yes					
	Nectar-like consistency	Yes					
	Honey-thick consistency	Yes					
	Pudding-thick consistency Blended-porridge	Yes Yes					
	Soft-chew	Yes					
	Solid	Yes					
x.	**SUMMARY**						

	Assume that you have completed the food and water test. This is the finding for the patient:	**Patient passed trial swallows on all consistencies.**					
[E]	**Fiberoptic endoscopic examination of swallowing (FEES) interpretation**						
i.	**Video 1**						
	Structural observation of the larynx						
	Any secretions observed?	NAD					
	Is the vocal fold (VF) symmetrical?	Yes					
	VF mobility	NAD					
ii.	**Video 2**						
	Pooling of saliva	NAD					
	Initiation of swallow	Prompt					
	Premature spillage	No					
	PenAsp Score	Level 1					
	Post-swallow residue	No					
	White-out	Complete					
iii.	**Video 3**						
	Pooling of saliva	NAD					
	Initiation of swallow	Prompt					
	Premature spillage	No					
	PenAsp Score	Level 1					
	Post-swallow residue	No					
	White-out	Complete					
[F]	**Results and diagnostic impression**						

i.	Let's say you have completed FEES for this patient. Below are the important findings recorded:						
ii.	*Based on all investigations, patient **MAY** have these symptoms or physiologic abnormalities*						
	No abnormalities detected	Yes					
	Reduced glossopalatal seal	No					
	Poor oral control/propulsion	No					
	Reduced velopharyngeal closure	No					
	Reduced BOT-PPW approximation	No					
	Reduced pharyngeal contraction	No					
	Reduced hyolaryngeal excursion	No					
	Reduced UES opening	No					
	Early closure of UES	No					
iii.	Based on the assessments you have done so far, what is your impression on the **possible diagnosis** of this patient?	Normal swallowing					
iv.	*characterized by:*						
	No Abnormalities Detected (NAD)	Yes					
	reduced oral manipulation	No					
	premature spillage secondary to reduced glossopalatal seal	No					
	delayed swallow trigger	No					
	incomplete epiglottic deflection	No					
	incomplete white-out	No					
	reduced UES opening	No					
	penetration/ aspiration **before** swallow	No					

	penetration/aspiration **during** swallow	No					
	penetration/ aspiration **after** swallow	No					
v.	*secondary to:*						
	inadequate bolus preparation	No					
	glossopalatal seal/approximation	No					
	delayed swallow trigger	No					
	pharyngeal pooling prior to onset of swallow	No					
	poor pharyngeal contraction	No					
	incomplete epiglottic deflection	No					
	residue overflow	No					
	others	No					
[H]	**Recommendations**						
i.	*Diet recommendation*						
	Normal diet	Yes					
	Diet modification	No					
	Volume modification	No					
	Nil by mouth (except for oral pleasure)	No					
ii.	*Compensatory technique*						
	Thickened liquid/consistencies	No					
	Chopped or pureed diet	No					
	Cyclic ingestion	No					
	Thermal-tactile stimulation	No					
	Increased taste-sour bolus	No					
	Head turn/head tilt	No					
	Chin tuck	No					
iii.	*Rehabilitation technique*						
	Supraglottic swallow	No					

	Super-supraglottic swallow Oromotor exercises	No No					
	Masako Maneuver	No					
	Shaker's Exercise/Chin Tuck Against Resistance (CTAR)	No					
	Mendelsohn Maneuver	No					
	Effortful swallow	No					
	Vital stim	No					
iv.	*Other recommendations*						
	Repeat FEES in	No					
	Refer to other professional(s)	No					
	Congratulations! Case 1 completed!						

Additional comment:

APPENDIX E: EXPERT VALIDATION FORM II

EXPERT VALIDATION FORM

The current Ph.D. work aims to develop an interactive self-training system for dysphagia training (ISD). Therefore, we seek to validate the script content, language and materials used in the ISD cases. You will be provided with a validation form and four URLs to four ISD cases. You were invited to use the ISD during this validation period and to fill out the validation form while using the ISD. The ISD cases are accessible via computer and mobile device. However, some of the images on the smartphone version may be interrupted. One ISD case will took around 20 to 30 minutes to complete.

1) The cases in the ISD are suitable to be used for students' training.
   Please rate your agreement with the statement above for Case 1 to Case 4 using the following scale:
   1: Strongly Disagree
   2: Disagree
   3: Agree
   4: Strongly Agree

	1	2	3	4
Case 1				
Case 2				
Case 3				
Case 4				

2) Please rate the difficulty level of Case 1 to Case 4 in the ISD following the scale of: Easy – Moderate – Difficult

	Easy	Moderate	Difficult
Case 1			
Case 2			
Case 3			
Case 4			

3) The simulated patient images presented in the ISD are suitable to be used for students' training.

Please rate your agreement with the statement above for Case 1 to Case 4 using the following scale:

1: Strongly Disagree

2: Disagree

3: Agree

4: Strongly Agree

	1	2	3	4
Case 1				
Case 2				
Case 3				
Case 4				

4) The FEES clips in the ISD are suitable to be used for students' training.

Please rate your agreement with the statement above for Case 1 to Case 4 using the following scale:

1: Strongly Disagree

2: Disagree

3: Agree

4: Strongly Agree

	1	2	3	4
Case 1				
Case 2				
Case 3				
Case 4				

APPENDIX F: USER ACCEPTANCE FORM

User Acceptance Form for the ISD

Based on your experience utilizing the ISD software prototype, kindly rate the following items using the provided scoring system.

	Score				
	1	**2**	**3**	**4**	**5**
Item	Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree

Item	Score				
Perceived Ease of Use	1	2	3	4	5
The ISD is interesting to use.					
The ISD is easy to use.					
The ISD is interactive.					
The response feedback in the ISD is helpful.					
Multimedia Element					
Appropriate font type.					
Appropriate font size.					
Appropriate colour.					
Appropriate background audio.					
Navigation					
Navigation is easy.					
Navigation is clear.					
Suitability					
The ISD is suitable to be used to train SLT students.					
The ISD is suitable to be used to test SLT students.					
The ISD can be used without written instructions.					

Additional recommendation:

_____

_____

_____

_____

_____

_____

APPENDIX G: MANUAL GUIDELINE

Manual Instruction ISD Training System

Introduction

The ISD training system is a simulation based on 360 degree virtual tour application. In general, the view can be rotated by dragging the pointer inversely to the direction desired.

Main page

Click any button to start. It may take a few seconds proceed to the next page.

You will be guided to the aerial view of IIUM from the main entrance. If you wait for a while, the camera will automatically rotate to the left where you can see Kulliyyah of Allied Health Science building. Click on the arrow on the building to proceed.

Once you are guided to the KAHS building, rotate the view downward and click on the arrow to enter the building.

Once you have enter the building, click on the door to enter the IIUM Hearing & Speech Clinic.

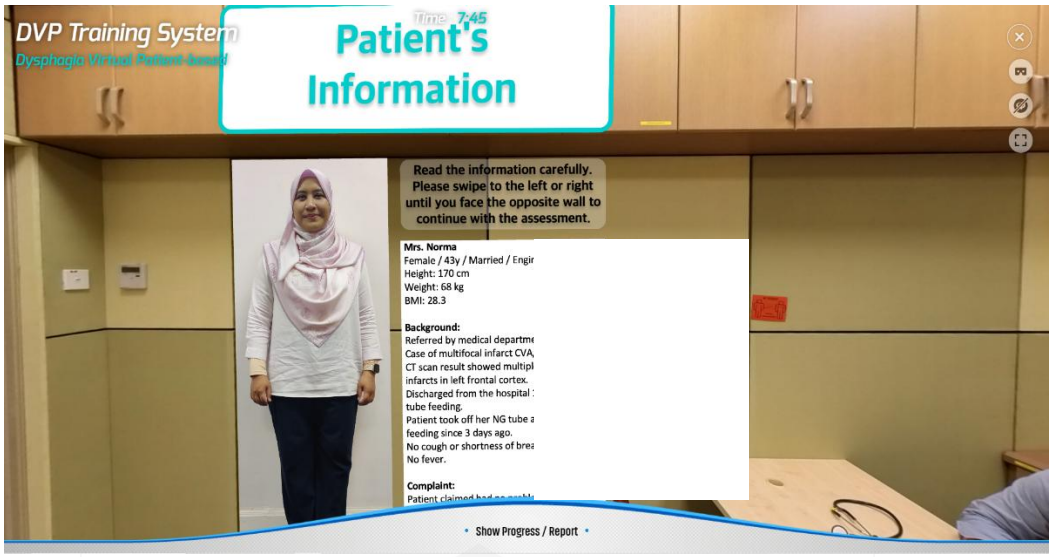
Alternately, you can easily access to the clinic by clicking on the Cases Room button at the bottom of the screen.

Cases Room

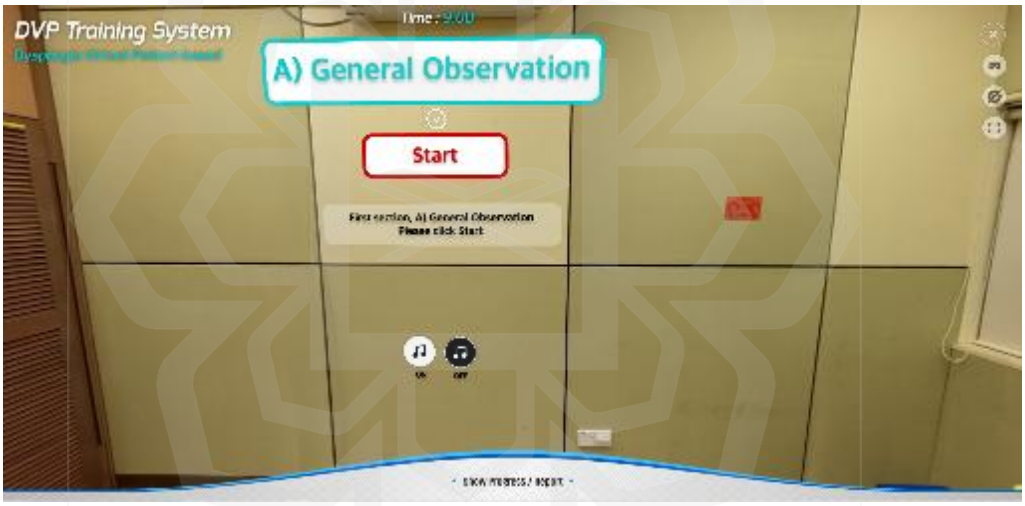
There are 4 Cases Room in this training system. Case 1 and 2 will be in front of you once you have entered the clinic, while Case 3 and 4 will be on your left back. Please rotate the view left or right to navigate through the clinic. You will need to complete Case 1 before Case 2 and so on.

Case

Once you have entered the cases room, you will be given Patient's information. Please read carefully all the information before proceeding to the assessment.

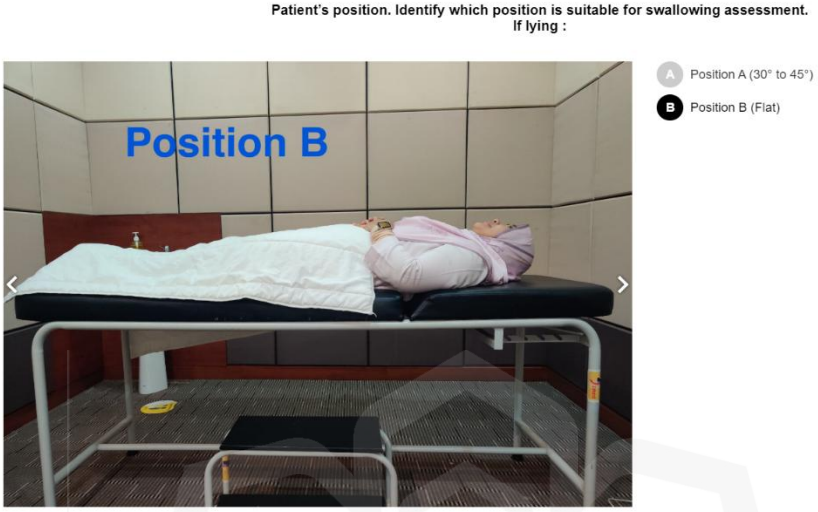


Rotate the view to your backside to start with the assessment by scrolling through the screen. You will also be given an option to turn off the background music.

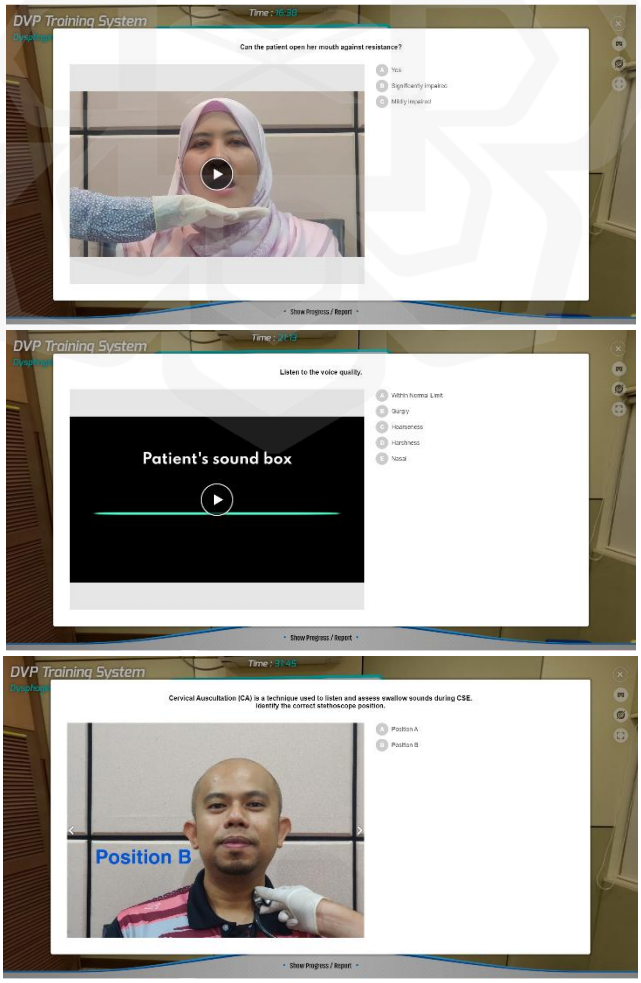


Please choose the right answer for each question. The correct answer will be in **green** colour while **red** is the wrong answer.

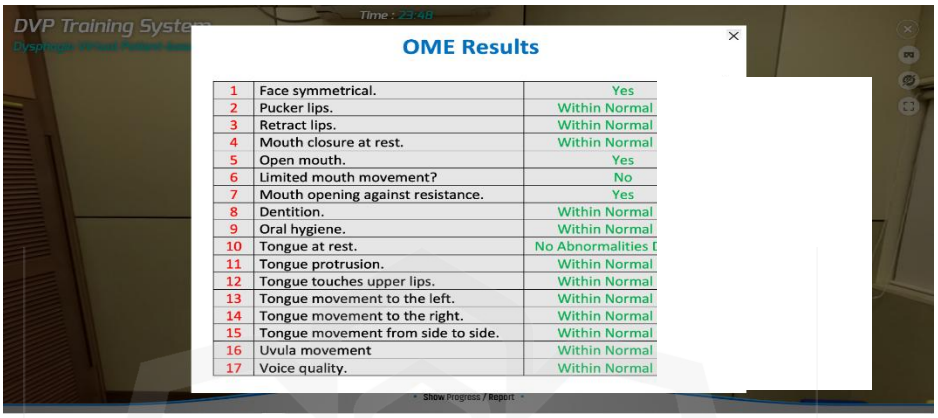
Once a question is answered, it may take a couple of seconds to proceed to the next question.



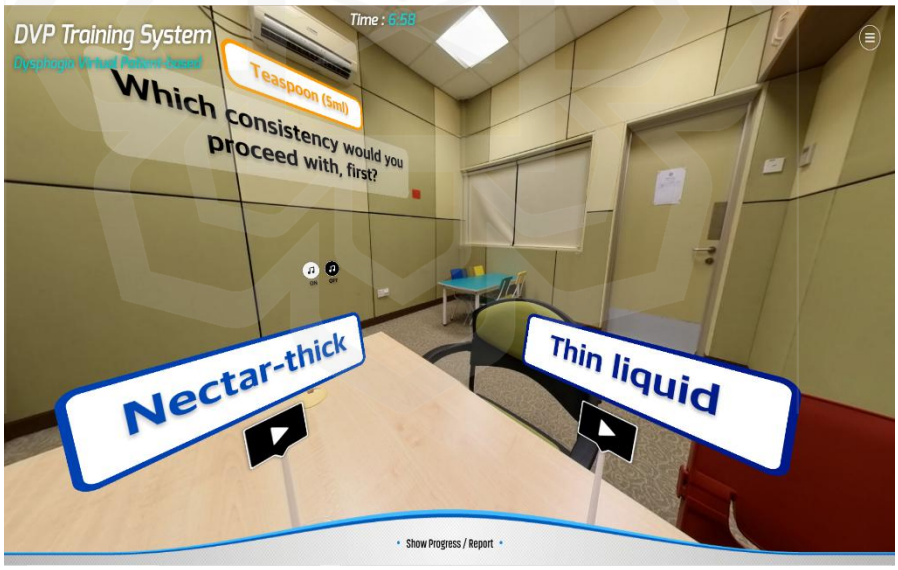
Some questions will require you to play video or sound recording, or to swipe between images. Please watch or listen to the media carefully before answering.



The assessments contain multiple section i.e. (A) General Observation, (B) Oral Motor Examination (C) Hyolaryngeal Excursion and Cervical Auscultation (D) Food and Water Test (E) FEES Interpretation (F) Result and Diagnostic Impression, (G) Possible Diagnosis, and (H) Recommendations. Once the examination is completed, you can view the overall result for Section (B), (D) and (E).

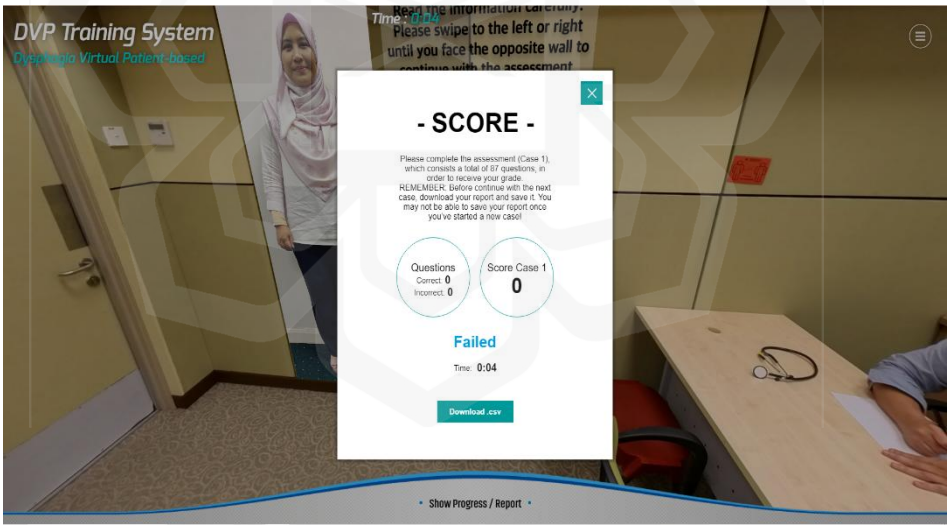


For Section (D) Food and Water Test, you may click the play button to watch the video of each liquid consistencies. Following this, click on the box of which consistency you would proceed with. Only the correct answer would bring you to the next question.



The number of how many trial you have done for the selected consistency can be seen on the table.

Before proceeding to next case, please download the .csv file by clicking the Show Progress/Report at the bottom of the screen.You won't be able to do it once exit. Compile your report for Case 1 until Case 4 and submit to the invigilator at the end of the training session.



ABBREVIATIONS

BOT – Base of tongue
FEES – Fiberoptic Evaluation of Swallowing
NAD – no abnormalities detected
PenAsp score – Penetration Aspiration Score
PPW – Posterior pharyngeal wall
UES – Upper Esophageal Sphincter
WNL – Within normal limit

APPENDIX H: RESEARCH INFORMATION SHEET

Research Information Sheet

Title	**:**	**The Development of an Interactive Self-training System for Dysphagia Management**
Researcher	**:**	**Natrah Ahmad Nordin** **Doctor Philosophy (PhD) Student** **Kulliyyah Allied Health Sciences** **International Islamic University Malaysia**
Supervisor	**:**	**Dr. Nor Azrita Mohamed Zain** **Lecturer (Speech-Language Therapy)** **Kulliyyah Allied Health Sciences** **International Islamic University Malaysia**

Thank you for your interest in joining this study. Please read all the information in this sheet. For further information, please contact the researcher Natrah binti Ahmad Nordin.

Purpose of study

The current PhD work aims to develop an interactive self-training system for dysphagia training (henceforth ISD). The ISD will be focusing on exercises to do oral-motor examination and making dysphagia diagnostic impression using Fiber Endoscoptic Examination of Swallowing (FEES) results. Since it is newly developed, we would like to look at the feasibility and effectiveness of the system. We are also interested in gathering user's feedback to improve the ISD.

Who is able to participate in this study?

This study welcomes ALL speech-language therapy students who have already completed the one semester undergraduate dysphagia course at the university.

What will happen?

If you choose to participate, you will first asked to complete a dysphagia case via Google form link. After that, you will be grouped randomly: in the ISD training group **OR** classroom-based training group. During the training, you will be asked to solve four dysphagia cases during the four hours period. If you are in the ISD group, you will be asked to complete the System Usability Questionnaire (SUS) and Instructional Motivation Survey (IMMS) and as well. Once the training completed, you will be asked to complete another dysphagia case via Google form link. If you are in the classroom-based group training, fret not, you will be allowed to access to the ISD at your own place, after the training complete. The link will be accessible for a week.

What are the possible benefits of taking part?

You will receive FREE dysphagia training either using the ISD or classroom-based method (tutorial) that will be held at your own university. During this course, dysphagia diagnosis after CSE and FEES interpretation skills will be discussed.

What are the possible risks of taking part?
There are no risks associated with the study. However, this research requires a time commitment from you during the training session.

What are your rights?
Your participation in this study is voluntary. By signing the consent form, it will be understood that you have consented to participate in the project, and that you consent to publication of the results of the project with the understanding that anonymity will be preserved. Your data will remain confidential. Withdrawal is possible at any time of the study. Hard copies of the consent forms and participant response sheets will be stored separately in locked filing cabinets in the department's office, while the soft copies will be saved in a password-protected computer. The information data will be analysed and written up as academic research and where appropriate, used as teaching materials.

Inquiries
If you have any questions, concerns, or reports regarding your rights as a research subject, please contact;

Researcher:	**Supervisor:**
Natrah Ahmad Nordin	Dr. Nor Azrita Mohamed Zain
natrah@iium.edu.my	znazrita@iium.edu.my
012-2011046	09-5706400 Ext: 3318

Thank you for your time reading this project information sheet and considering taking part in the study.

INTERACTIVE SELF-TRAINING SYSTEM FOR DYSPHAGIA MANAGEMENT (ISD)

Researchers: Natrah Ahmad Nordin (PhD student), Dr Nor Azrita Mohamed Zain (Primary Supervisor)

I, _____, have read and I understand the Information Sheet about taking part in this study designed to investigate the effectiveness of the ISD. I have had the opportunity to discuss this study. I am satisfied with the answers I have been given.

I have had this project explained to me by _____.

- I agree to maintain strict confidentiality regarding the ISD and its contents. I shall not disclose, distribute, or share any information, including but not limited to the link, screenshots, or any other form of reproduction, to any third party prior written consent from the researcher.
- I understand that taking part in this study is voluntary. I understand that I can withdraw from the study at any time.
- I understand that this study involves 4 hours training and requires me to two assessments.
- I understand that if I am grouped in either one of the two training groups, it requires me to analyse four dysphagia cases.
- I understand that if I am in the ISD training group, I am required to answer two feedbacks survey for this research.
- I understand that my name will never be used in the research project or in any other presentation or publication.
- I understand that the data I provide will be used for a PhD's thesis that will be submitted for assessment. I understand that the overall findings may be submitted for publication in a scientific journal or scientific conferences.
- I understand that the anonymous data collection sheets and surveys will be stored indefinitely and may be used in future research projects and internal presentations.

- I agree to take part in this research.

I, hereby consent to take part in the study.

Partcipant's Name: Signature:	Participant's IC No: Date:
Researcher's Name: Signature:	 Date:

APPENDIX I: DEMOGRAPHIC INFORMATION SHEET

Participant ID: _____

Demographic Information Sheet

1. What grade did you obtained for the subject Swallowing Disorders on the previous semester? _____

2. How many training hours during clinical placement have you completed for dysphagia cases management? _____

3. Are you familiar with Fiberoptic Evaluation of Swallowing (FEES?) Yes / No

4. How many hours of FEES observation (video) have you received? _____

5. How many hours of FEES observation (hands-on during clinical training) have you received? _____

6. In a scale of 1 to 10, rate your confidence in managing dysphagia cases.

Not confident Confident

1----2----3----4---5----6----7----8----9---10

7. In a scale of 1 to 10, rate your confidence in doing FEES interpretation.

Not confident Confident

1----2----3----4---5----6----7----8----9---10

APPENDIX J: TRAINING FORM

Participant ID:_____

CASE-BASED SWALLOWING MANAGEMENT TRAINING

Case No: 1/2/3/4

No	Question	Answer
[A]	**General observation**	
i.	*Patient's position.* 1. Identify which position is suitable for swallowing assessment. If lying*:*	A. Position A (30° to 45°) B. Position B (Flat)
	2. Identify which position is suitable for swallowing assessment. If sitting*:*	A. Position A (90°) B. Position B (120°)
[B]	**Oral Motor Examination (OME)**	
i.	*Face, lips, and jaw* 1. Is the face symmetrical?	A. Yes B. No
	2. Can the patient pucker her lips?	A. Within normal limit (WNL) B. Impaired
	3. Can the patient retract her lips?	A. Within normal limit (WNL) B. Impaired
	4. Observe mouth closure at rest.	A. Within normal limit (WNL) B. Significantly impaired C. Mildly impaired
	5. Can the patient open her mouth?	A. Yes B. No
	6. Limited movement?	A. Yes B. No
	7. Can the patient open her mouth against resistance?	A. Yes B. Impaired

ii.	*Oral cavity* 1. Any missing teeth? Observe the dentition.	A. Within normal limit (WNL) B. Missing teeth not replaced C. Dentition
	2. Observe the oral hygiene.	A. Within normal limit (WNL) B. Fair C. Poor
iii.	*Tongue* 1. How is the tongue at rest?	A. No abnormalities detected (NAD) B. Lesion C. Fasciculation D. Abnormal size
	2. Can the patient protrude her tongue?	A. Within normal limit (WNL) B. Deviated to the right C. Deviated to the left
	3. Can the patient touch her upper lips with the tip of her tongue?	A. Within normal limit (WNL) B. Impaired
	4. Can the patient move her tongue to the left?	A. Within normal limit (WNL) B. Impaired
	5. Can the patient move her tongue to the right?	A. Within normal limit (WNL) B. Impaired
	6. Can the patient move her tongue from side to side? [check]	[ ] Within normal limit (WNL) [ ] Impaired left [ ] Impaired right

iv.	*Palate* 1. Observe the uvula movement. Movement:	A. Within normal limit (WNL) B. Impaired
	2. Listen to the voice quality.	[ ] Within normal limit (WNL) [ ] Gurgly [ ] Roughness [ ] Nasal [ ] Breathiness
v.	*OME Results* *What can you conclude on the cranial nerves function?*	(refer to table in the slide)
	Trigeminal nerve	Intact / Impaired
	Facial nerve	Intact / Impaired
	Glossopharyngeal nerve	Intact / Impaired
	Vagus nerve	Intact / Impaired
	Hypoglossal nerve	Intact / Impaired
[C]	**Hyolaryngeal excursion and cervical auscultation**	
i.	*1. Hyolaryngeal Excursion* Hyolaryngeal excursion (HE) is often assessed through palpation during clinical swallowing examination (CSE). Identify the correct position:	A. Position A B. Position B
	2. Cervical Auscultation Cervical Auscultation (CA) is a technique used to listen and assess swallow sounds during CSE. Identify the correct stethoscope position:	A. Position A B. Position B
[D]	**Food and Water Test**	
i.	1. *Dry swallow* Prior to food and water testing, observe the patients' ability to swallow her saliva. Observe hyolaryngeal excursion, spontaneous throat clearing, and/or coughing.	

<table>
<tr><td></td><td>2. Which volume would you proceed with, first?</td><td>C. Teaspoon (5ml)
D. Tablespoon (10ml)
E. Cup (30 ml)</td></tr>
<tr><td></td><td>3.Which consistency would you proceed with, first?</td><td>A. Thin liquid
B. Nectar-thick
C. Honey-thick
D. Pudding-thick</td></tr>
<tr><td>ii.</td><td>Consistency: _____ (_____/__ml)
Laryngeal displacement observation:
(WNL / Limited movement observed)
1. Listen carefully. What did you hear?</td><td>A. Single swallow sound
B. Double swallow sounds
C. Multiple swallow sounds</td></tr>
<tr><td></td><td>2. Spontaneous cough?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td>3. Spontaneous throat clearing?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td>4. Another sip?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td colspan="2">5. Trial(s)
<table>
<tr><th>Another sip?</th><th>Swallow sound</th><th>Cough</th><th>Throat Clearing</th></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
</table></td></tr>
<tr><td></td><td>6. Will you upgrade utensil/increase volume?</td><td>A. Yes B. No</td></tr>
</table>

<table>
<tr><td>iii.</td><td>Consistency: _____
(_____/____ml)
Laryngeal displacement observation:
(WNL / Limited movement observed)
1. Listen carefully. What did you hear?</td><td>A. Single swallow sound
B. Double swallow sounds
C. Multiple swallow sounds</td></tr>
<tr><td></td><td>2. Spontaneous cough?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td>3. Spontaneous throat clearing?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td>4. Another sip?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td colspan="2">5. Trial(s)
<table>
<tr><th>Another sip?</th><th>Swallow sound</th><th>Cough</th><th>Throat Clearing</th></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
<tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr>
</table></td></tr>
<tr><td></td><td>6. Will you upgrade utensil/increase volume?</td><td>A. Yes B. No</td></tr>
<tr><td>iv.</td><td>Consistency: _____
(_____/_____ml)
Laryngeal displacement observation:
(WNL/Limited movement observed)
1. Listen carefully. What did you hear?</td><td>A. Single swallow sound
B. Double swallow sounds
C. Multiple swallow sounds</td></tr>
<tr><td></td><td>2. Spontaneous cough?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td>3. Spontaneous throat clearing?</td><td>A. Yes B. No</td></tr>
<tr><td></td><td colspan="2">4. Trial (s)</td></tr>
</table>

	<table><tr><th>Another sip?</th><th>Swallow sound</th><th>Cough</th><th>Throat Clearing</th></tr><tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr><tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr><tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr><tr><td>Yes/No</td><td>Single/Double/Multiple</td><td>Yes/No</td><td>Yes/No</td></tr></table>	
v.	Which consistency(ies) would you proceed now? None	Yes / No
	Ice-chips	Yes / No
	Nectar-like consistency	Yes / No
	Honey-thick consistency	Yes / No
	Pudding-thick consistency	Yes / No
	Blended-porridge	Yes / No
	Soft-chew	Yes / No
	Solid	Yes / No
vi.	**SUMMARY** Assume that you have completed the food and water test. This is the finding for the patient:	(refer to slide)
[E]	**Fiberoptic endoscopic examination of swallowing (FEES) interpretation**	
i.	**Video 1** *Structural observation of the larynx*	
	1. Any secretions observed?	A. No abnormalities detected B. B. Yes
	2. Is the vocal fold (VF) symmetrical?	A. Yes B. Abnormal left C. Abnormal right

	3. Vocal fold (VF) mobility	A. No abnormalities detected (NAD) B. Compensated C. Immobile left D. Immobile right
	4. Other abnormalities of the vocal fold (VF)?	A. Swollen B. Vocal nodules C. Polyps D. None
ii.	**Video 2**	Consistency:
	1. Pooling of saliva?	A. No Abnormalities detected (NAD) B. B. Yes
	2. At down to which level does the pooling of saliva occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
	3. What is the severity of the pooling?	Mild / Moderate / Severe
	4. Initiation of swallow	Prompt / Delayed
	5. Premature spillage	Yes / No
	6. At down to which level does the premature spillage occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
	7. What is the severity of the premature spillage?	Mild / Moderate / Severe

	8. Penetration-Aspiration Score	A. Level 1: Material does not enter the airway. B. Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway. C. Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway. D. Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway. E. Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway. F. Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway. G. Level 7: Material enters the airway, passess below the vocal folds, and is not ejected from the trachea despite effort. H. Level 8: Material enters the airway, passess below the vocal folds, and no effort is made to reject.
	9. White-out	Complete / Incomplete
	10. Post-swallow residue	No abnormality detected / Yes
	11. At down to which level does the post-swallow residue occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
		Mild / Moderate / Severe

	12. What is the severity of the post-swallow residue?	
ii.	**Video 3**	Consistency:
	1. Pooling of saliva	A. No Abnormalities detected (NAD) B. B. Yes
	2. At down to which level does the pooling of saliva occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
	3. What is the severity of the pooling?	Mild / Moderate / Severe
	4. Initiation of swallow	Prompt / Delayed
	5. Premature spillage?	Yes / No
	6. At down to which level does the premature spillage occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
	7. What is the severity of the premature spillage?	Mild / Moderate / Severe
	8. Penetration-Aspiration Score	A. Level 1: Material does not enter the airway. B. Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway. C. Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway.

		D. Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway. E. Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway. F. Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway. G. Level 7: Material enters the airway, passess below the vocal folds, and is not ejected from the trachea despite effort. H. Level 8: Material enters the airway, passess below the vocal folds, and no effort is made to reject.
	9. White-out	Complete/Incomplete
	10. Post-swallow residue	No abnormality detected / Yes
	11. At down to which level does the post-swallow residue occurred? (check)	[ ] PPW [ ] Valleculae [ ] Left pyriform sinus [ ] Right pyriform sinus
	12. What is the severity of the post-swallow residue?	Mild / Moderate / Severe
[F]	**Results and diagnostic impression**	
i.	Let's say you have completed FEES for this patient. Below are the important findings recorded:	(refer to slide)
ii.	*Based on all investigations, patient **MAY** have these symptoms or physiologic abnormalities*	
	No abnormalities detected	Yes / No
	Reduced glossopalatal seal	Yes / No
	Poor oral control/propulsion	Yes / No

	Reduced velopharyngeal closure	Yes / No
	Reduced BOT-PPW approximation	Yes / No
	Reduced pharyngeal contraction	Yes / No
	Reduced hyolaryngeal excursion	Yes / No
	Reduced UES opening	Yes / No
	Early closure of UES	Yes / No
iii.	Based on the assessments you have done so far, what is your impression on the **possible diagnosis** of this patient?	A. B. C.
iv.	*characterized by:* no abnormalities detected (NAD)	Yes / No
	reduced oral manipulation	Yes / No
	premature spillage secondary to reduced glossopalatal seal	Yes / No
	delayed swallow trigger	Yes / No
	incomplete epiglottic deflection	Yes / No
	incomplete white-out	Yes / No
	reduced UES opening	Yes / No
	penetration/ aspiration **before** swallow	Yes / No
	penetration/aspiration **during** swallow	Yes / No
	penetration/ aspiration **after** swallow	Yes / No
v.	*secondary to:* inadequate bolus preparation	Yes / No
	glossopalatal seal/approximation	Yes / No
	delayed swallow trigger	Yes / No
	pharyngeal pooling prior to onset of swallow	Yes / No
	poor pharyngeal contraction	Yes / No
	incomplete epiglottic deflection	Yes / No

	residue overflow	Yes / No
[H]	**Recommendations**	
i.	*Diet recommendation* Normal diet	Yes / No
	Diet modification	Yes / No
	Volume modification	Yes / No
	Nil by mouth (except for oral pleasure)	Yes / No
ii.	*Compensatory technique* Thickened liquid/consistencies	Yes / No
	Chopped or pureed diet	Yes / No
	Cyclic ingestion	Yes / No
	Thermal-tactile stimulation	Yes / No
	Increased taste-sour bolus	Yes / No
	Head turn/head tilt	Yes / No
	Chin tuck	Yes / No
iii.	*Rehabilitation technique* Supraglottic swallow	Yes / No
	Super-supraglottic swallow	Yes / No
	Oromotor exercises	Yes / No
	Masako Maneuver	Yes / No
	Shaker's Exercise/Chin Tuck Against Resistance (CTAR)	Yes / No
	Mendelsohn Maneuver	Yes / No
	Effortful swallow	Yes / No
iv.	*Other recommendations* 1. Repeat FEES in	A. 6/52 B. 1/12 C. None
	2. Refer to other professional(s)	[ ] None

		[ ] Dietitian [ ] Neurologist [ ] Gastroenterologist

APPENDIX K: CASE A

Dysphagia Management: Case A

This quiz consists of 10 sections, which include the information and dysphagia management protocol of a case study. Some theoretical questions might also be included which may or may not be related to the case but are still relevant in dysphagia management protocol.

SECTION 1 Background Information

Kindly read the information carefully.

Mrs Tiara
Female/38 years old/Officer
Height: 152 cm
Weight: 40 kg
BMI: 17.8 kg/meter squared
Background:
Referred by medical department.
Stage 3 breast cancer, on chemotherapy.
Complaint: Lethargy and poor oral intake 1/12. Will choke and cough especially when taking fluid, better with soft diet or solid food.

SECTION 2 Patient's position

Kindly choose the best answer.

Identify which position is suitable for swallowing assessment. If lying:
Flat [IMAGE]
30 degrees to 45 degrees [IMAGE]

Identify which position is suitable for swallowing assessment. If sitting:
90 degrees [IMAGE]
120 degrees [IMAGE]

SECTION 3 Oral Motor Examination (OME)

Kindly choose the best answer based on your observation. Some questions might require you to listen to recorded video/audio.

1. [IMAGE] Is the face symmetrical?
   A. Yes
   B. No

2. [IMAGE] Can the patient pucker her lips?
   A. Within Normal Limit (WNL)
   B. Impaired

3. [IMAGE] Can the patient retract her lips?
   A. Within Normal Limit (WNL)
   B. Impaired

4. [IMAGE] Observe mouth closure at rest.
   A. Within Normal Limit (WNL)
   B. Significantly Impaired
   C. Mildly Impaired

5. [IMAGE] Can the patient open her mouth?
   A. Yes
   B. No

6. Limited mouth opening?
   A. Yes
   B. No

7. [Video] Can the patient open her mouth against resistance?
   A. Yes
   B. Impaired

8. Any missing teeth? Observe the dentition.
   A. Within normal limit (WNL)
   B. Missing teeth not replaced
   C. Dentures

9. One of the aspects assessed in OME is oral hygiene. Why is oral hygiene important for patients with dysphagia?
   A. Reducing the risk of aspiration.
   B. Reducing the chances of developing pneumonia.
   C. Reducing saliva accumulation.

10. [IMAGE] How is the tongue at rest?
    A. No abnormalities detected (NAD)
    B. Lesioned
    C. Fasciculation
    D. Abnormal size

11. [IMAGE] Can the patient protrude her tongue?
    A. Within Normal Limit (WNL)
    B. Impaired

12. [IMAGE] Can the patient touch her upper lip with the tip of her tongue?
    A. Within Normal Limit (WNL)

B. Impaired

13. [IMAGE] Can the patient move her tongue to the left?
    A. Within Normal Limit (WNL)
    B. Impaired

14. [IMAGE] Can the patient move her tongue to the right?
    A. Within Normal Limit (WNL)
    B. Impaired

15. [Video] Can the patient move her tongue from side to side?
    A. Within Normal Limit (WNL)
    B. Impaired Left
    C. Impaired Right

16. [Voice recording] Listen to the voice quality. [more than 1 answer is allowed]
    [ ] Within Normal Limit (WNL)
    [ ] Gurgly
    [ ] Breathiness
    [ ] Nasal
    [ ] Roughness

17. Based on the OME above, what can you conclude on the cranial nerves' functions for this patient?

	Intact	Impaired
Trigeminal nerve (CN V)	[ ]	[ ]
Facial nerve (CN VII)	[ ]	[ ]
Glossopharyngeal nerve (CN IX)	[ ]	[ ]
Vagus nerve (CN X)	[ ]	[ ]
Hypoglossal nerve (CN XII)	[ ]	[ ]

SECTION 4 Hyolaryngeal excursion and cervical auscultation
Kindly choose the best answer.

Hyolaryngeal excursion (HE) is often assessed through palpation during clinical swallowing examination (CSE). Identify the correct position:
[Position A]
[Position B]

Cervical auscultation (CA) is a technique used to listen and assess swallowing sounds during CSE. Identify the best position for placement of the stethoscope:
[Position A]
[Position B]

SECTION 5 Food and water test (Part 1)

Kindly choose the best answer.

Prior to food and water testing, it is a practice to observe dry swallow. After observing dry swallow, which volume would you proceed with this patient, first?

Teaspoon (5 ml)
Tablespoon (10 ml)
Cup (90 ml)

And which consistency would you proceed with this patient first?

Thin liquid
Nectar-thick
Honey-thick
Pudding-thick

How much volume of water is used in the Yale Swallow Protocol?

20ml
50ml
90ml

SECTION 6 Food and water test (Part 2)

Observe the video given through the links and provide your findings.

1. We are now testing the patient with 5 ml of thin liquid using teaspoon. Limited movement was observed for hyolaryngeal excursion. Play the video and listen carefully. What did you hear?
   A. Single swallow sound
   B. Double swallow sounds
   C. Multiple swallow sounds

2. By listening to the same video, identify if cough and/or throat clearing is present?

	Yes	No
Cough	[ ]	[ ]
Throat clearing	[ ]	[ ]

3. The 5-ml thin liquid testing was repeated 3 times with similar findings. Which consistency(ies) would you proceed with this patient?

	Yes	No
None	[ ]	[ ]
Ice chips	[ ]	[ ]
Honey-thick consistency	[ ]	[ ]
Porridge	[ ]	[ ]
Solid	[ ]	[ ]

SECTION 7 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[Video 1] *Structural observation of the larynx.*

Observe the video given through the link and record your observation.

Any secretions observed?

No abnormalities detected (NAD)

Yes

Are the vocal folds (VF) symmetrical? [more than 1 answer is allowed]

[ ] Yes

[ ] Abnormal left

[ ] Abnormal right

Vocal folds (VF) mobility

	Yes	No
No abnormalities detected (NAD)	[ ]	[ ]
Immobile left	[ ]	[ ]
Immobile right	[ ]	[ ]
Compensated	[ ]	[ ]
Incomplete closure	[ ]	[ ]

SECTION 8 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[VIDEO 2] *FEES was conducted using thin liquid. Record your observation and findings.*

1. Pooling of saliva?

No Abnormalities Detected (NAD)

Yes

At down to which level does the pooling of saliva occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

What is the severity of the pooling?

A. Mild

B. Moderate

C. Severe
D. Not relevant

4. Initiation of swallow
   A. Prompt
   B. Delayed

5. Premature spillage?
   A. Yes
   B. No

6. At down to which level does the premature spillage occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

7. What is the severity of the premature spillage?
   A. Mild
   B. Moderate
   C. Severe
   D. Not relevant

8. Penetration Aspiration Score (PenAsp score)
   Level 1: Material does not enter the airway.
   Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway.
   Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
   Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway.
   Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
   Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
   Level 7: Material enters the airway, passess below the vocal folds, and is not ejected from the trachea despite effort.
   Level 8: Material enters the airway, passess below the vocal folds, and no effort is made to reject.

9. White out
   A. Complete

B. Incomplete

10. Post-swallow residue?
    A. No abnormalities detected (NAD)
    B. Yes

11. At down to which level does the post-swallow residue occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

12. What is the severity of the post-swallow residue?
    A. Mild
    B. Moderate
    C. Severe
    D. Not relevant

SECTION 9 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[Video 3] *FEES was also conducted using porridge. Record your observation and findings.*

1. Pooling of saliva?
    A. No Abnormalities Detected (NAD)
    B. Yes

2. At down to which level does the pooling of saliva occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

3. What is the severity of the pooling?
    A. Mild
    B. Moderate
    C. Severe
    D. Not relevant

4. Initiation of swallow
   A. Prompt
   B. Delayed

5. Premature spillage?
   A. Yes
   B. No

6. At down to which level does the premature spillage occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

7. What is the severity of the premature spillage?
   A. Mild
   B. Moderate
   C. Severe
   D. Not relevant

8. Penetration Aspiration Score (PenAsp score)
   A. Level 1: Material does not enter the airway.
   B. Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway.
   C. Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
   D. Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway.
   E. Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
   F. Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
   G. Level 7: Material enters the airway, passess below the vocal folds, and is not ejected from the trachea despite effort.
   H. Level 8: Material enters the airway, passess below the vocal folds, and no effort is made to reject.

9. White out
   A. Complete
   B. Incomplete

10. Post-swallow residue?
    A. No abnormalities detected (NAD)
    B. Yes

11. At down to which level does the post-swallow residue occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

12. What is the severity of the post-swallow residue?
    A. Mild
    B. Moderate
    C. Severe
    D. Not relevant

SECTION 10 Results and diagnostic impression

1. Based on all investigations, patient MAY have these symptoms or physiologic abnormalities

	Yes	No
Reduced glossopalatal seal	[ ]	[ ]
Poor oral control/propulsion	[ ]	[ ]
Reduced BOT-PPW approximation	[ ]	[ ]
Reduced pharyngeal contraction	[ ]	[ ]
Reduced hyolaryngeal excursion	[ ]	[ ]
Reduced UES opening	[ ]	[ ]
Early closure of UES	[ ]	[ ]

2. Based on the assessments you have done so far, what is your impression on the possible diagnosis of this patient?
    A. Mild oropharyngeal dysphagia
    B. Mild to moderate pharyngeal dysphagia
    C. Mild pharyngeal dysphagia

3. Which compensatory technique(s) would you choose for the patient?

	Yes	No
Thickened liquid/consistencies	[ ]	[ ]
Cyclic ingestion	[ ]	[ ]
Thermal-tactile stimulation	[ ]	[ ]

Increase taste-sour bolus	[ ]	[ ]
Head turn/head tilt	[ ]	[ ]

4. Which rehabilitation technique(s) you may choose to the patient?

	Yes	No
Supraglottic swallow	[ ]	[ ]
Super-supraglottic swallow	[ ]	[ ]
Masako Maneuver	[ ]	[ ]
Shaker's Exercise/Chin Tuck Against Resistance (CTAR)	[ ]	[ ]
Mendelsohn Maneuver	[ ]	[ ]
Effortful swallow	[ ]	[ ]

APPENDIX L: CASE B

Dysphagia Management: Case B
This quiz consists of 9 sections, which include the information and dysphagia management protocol of a case study. Some theoretical questions might also be included which may or may not be related to the case but are still relevant in dysphagia management protocol.

SECTION 1 Background Information
Kindly read the information carefully.

Mr Ahmad
Male / 41 years old / Married / Government officer
Height: 170 cm
Weight: 109 kg
BMI: 37.7 kg/meter squared
Background:
Referred by neuromedical department.
Spino-cerebellar ataxia with multifocal cerebral infarcts.
Bed bound at home and on NG tube, but came on wheelchair.
Patient pulled off NG tube 1/12 ago, been on fluids and soft diet since then.
Complaint: Coughing episodes during oral feeding with shortness of breath.

SECTION 2 Patient's position
Kindly choose the best answer.

Identify which position is suitable for swallowing assessment. If lying:
Flat [IMAGE]
30 degrees to 45 degrees [IMAGE]

Identify which position is suitable for swallowing assessment. If sitting:

A. 90 degrees [IMAGE]
B. 120 degrees [IMAGE]

SECTION 3 Oral Motor Examination (OME)
Kindly choose the best answer based on your observation. Some questions might require you to listen to recorded video/audio.

1. [IMAGE] Is the face symmetrical?
   A. Yes
   B. Right-sided drooping
   C. Left-sided drooping

2. [IMAGE] Can the patient pucker his lips?
   A. Within Normal Limit (WNL)
   B. Impaired

3. [IMAGE] Can the patient retract his lips?
   A. Within Normal Limit (WNL)

B. Impaired

4. [IMAGE] Observe mouth closure at rest.
   A. Within Normal Limit (WNL)
   B. Significantly Impaired
   C. Mildly Impaired

5. [IMAGE] Can the patient open his mouth?
   A. Yes
   B. No

6. [Video] Can the patient open his mouth against resistance?
   A. Yes
   B. Impaired

7. [IMAGE] How is the tongue at rest?
   A. No abnormalities detected (NAD)
   B. Fasciculation
   C. Deviated to the right
   D. Deviated to the left

8. [IMAGE] Can the patient protrude his tongue?
   A. Within Normal Limit (WNL)
   B. Yes, deviated to the right
   C. Yes, deviated to the left
   D. No

9. [IMAGE] Can the patient touch his upper lip with the tip of his tongue?
   A. Within Normal Limit (WNL)
   B. Impaired

10. [IMAGE] Can the patient move his tongue to the left?
    A. Within Normal Limit (WNL)
    B. Impaired

11. [IMAGE] Can the patient move his tongue to the right?
    A. Within Normal Limit (WNL)
    B. Impaired

12. [Video] Observe the uvula movement. Movement?
    A. Within Normal Limit (WNL)
    B. Impaired

13. [Voice recording] Listen to the voice quality. [more than 1 answer is allowed]

    [ ] Within Normal Limit (WNL)
    [ ] Gurgly

[ ] Breathiness
[ ] Nasal
[ ] Roughness

14. Based on the OME above, what can you conclude on the cranial nerves' functions for this patient?

	Intact	Impaired
Trigeminal nerve (CN V)	[ ]	[ ]
Facial nerve (CN VII)	[ ]	[ ]
Glossopharyngeal nerve (CN IX)	[ ]	[ ]
Vagus nerve (CN X)	[ ]	[ ]
Hypoglossal nerve (CN XII)	[ ]	[ ]

15. What cranial nerves are involved in the formation of pharyngeal plexus?

	Yes	No
Trigeminal nerve (CN V)	[ ]	[ ]
Facial nerve (CN VII)	[ ]	[ ]
Glossopharyngeal nerve (CN IX)	[ ]	[ ]
Vagus nerve (CN X)	[ ]	[ ]
Hypoglossal nerve (CN XII)	[ ]	[ ]

16. How do you assess the function of trigeminal nerve (CN V)?
    A. By asking the patient to pucker his lips
    B. By asking the patient to open his mouth against resistance
    C. By asking the patient to say /ah ah ah/
    D. By observing his facial asymmetry

SECTION 4 Hyolaryngeal excursion and cervical auscultation

Kindly choose the best answer.

1. Hyolaryngeal excursion (HE) is often assessed through palpation during clinical swallowing examination (CSE). Identify the correct position:
   [Position A]
   [Position B]

2. Cervical auscultation (CA) is a technique used to listen and assess swallowing sounds during CSE. Identify the best position for placement of the stethoscope:
   [Position A]
   [Position B]

SECTION 5 Food and water test

Observe the video given through the links and provide your findings.

1. Prior to food and water testing, it is a practice to observe dry swallow. After observing dry swallow, you saw that patient is struggling to swallow his own

saliva. Occasionally, coughing occurs. Which one of these would you proceed with this patient, first??

Teaspoon (5 ml) of porridge
Ice chips
Cup (90 ml) of water
Tablespoon (10 ml) of honey-thick liquid

2. [Click to view] The patient was given 5 ml of thin liquid using teaspoon. Limited movement was observed for hyolaryngeal excursion. Play the video and listen carefully. What did you hear?

Single swallow sound
Double swallow sounds
Multiple swallow sounds

3. [Click to view] By listening to the same video, identify if cough and/or throat clearing is present?

	Yes	No
Cough	[ ]	[ ]
Throat clearing	[ ]	[ ]

SECTION 6 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[Video 1] *Structural observation of the larynx. Observe the video given through the link and record your observation.*

1. Any pooling observed?

No abnormalities detected (NAD)
Yes

2. Are the vocal folds (VF) symmetrical? [more than 1 answer is allowed]

[ ] Yes
[ ] Abnormal left
[ ] Abnormal right

3. Vocal folds (VF) mobility

	Yes	No
No abnormalities detected (NAD)	[ ]	[ ]
Immobile left	[ ]	[ ]
Immobile right	[ ]	[ ]
Compensated	[ ]	[ ]
Incomplete closure	[ ]	[ ]

SECTION 7 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[VIDEO 2] FEES was conducted using thin liquid. Record your observation and findings.

1. Pooling of saliva?
   No Abnormalities Detected (NAD)
   Yes

2. At down to which level does the pooling of saliva occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

3. What is the severity of the pooling?
   A. Mild
   B. Moderate
   C. Severe
   D. Not relevant

4. Initiation of swallow
   Prompt
   Delayed

5. Premature spillage?
   Yes
   No

6. At down to which level does the premature spillage occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

7. What is the severity of the premature spillage?
   Mild
   Moderate
   Severe

Not relevant

8. Penetration Aspiration Score (PenAsp score)
   A. Level 1: Material does not enter the airway.
   B. Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway.
   C. Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway.
   D. Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway.
   E. Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
   F. Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
   G. Level 7: Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort.
   H. Level 8: Material enters the airway, passes below the vocal folds, and no effort is made to reject.

9. White out
   Complete
   Incomplete

10. Post-swallow residue?
    No abnormalities detected (NAD)
    Yes

11. At down to which level does the post-swallow residue occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

12. What is the severity of the post-swallow residue?
    Mild
    Moderate
    Severe
    Not relevant

SECTION 8 Fiberoptic endoscopic examination of swallowing (FEES) interpretation

[Video 3] FEES was also conducted using porridge. The first few seconds of the video shows pooling of saliva. Record your observation and findings.

1. What could be the reason of saliva pooling?

Incomplete closure of the vocal folds
Incomplete glossopalatal seal
Reduced pharyngeal contraction

2. Where does the pooling of saliva occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

3. What is the severity of the pooling?
   Mild
   Moderate
   Severe
   Not relevant

4. Initiation of swallow
   Prompt
   Delayed

5. Premature spillage?
   Yes
   No

6. At down to which level does the premature spillage occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

7. What is the severity of the premature spillage?
   Mild
   Moderate
   Severe
   Not relevant

8. Penetration Aspiration Score (PenAsp score)
   A. Level 1: Material does not enter the airway.
   B. Level 2: Material enters the airway, remains above the vocal folds, and is ejected from the airway.
   C. Level 3: Material enters the airway, remains above the vocal folds, and is not ejected from the airway.

D. Level 4: Material enters the airway, contacts the vocal folds, and is ejected from the airway.
E. Level 5: Material enters the airway, contacts the vocal folds, and is not ejected from the airway.
F. Level 6: Material enters the airway, passes below the vocal folds, and is ejected into the larynx or out of the airway.
G. Level 7: Material enters the airway, passes below the vocal folds, and is not ejected from the trachea despite effort.
H. Level 8: Material enters the airway, passes below the vocal folds, and no effort is made to reject.

9. White out
   A. Complete
   B. Incomplete

10. Post-swallow residue?
    A. No abnormalities detected (NAD)
    B. Yes

11. At down to which level does the post-swallow residue occur?

	Yes	No
Posterior pharyngeal wall (PPW)	[ ]	[ ]
Valleculae	[ ]	[ ]
Left pyriform sinus	[ ]	[ ]
Right pyriform sinus	[ ]	[ ]
Not relevant	[ ]	[ ]

12. What is the severity of the post-swallow residue?
    A. Mild
    B. Moderate
    C. Severe
    D. Not relevant

SECTION 10 Results and diagnostic impression

1. Based on OME and FEES, patient MAY have these symptoms or physiologic abnormalities

	Yes	No
Reduced glossopalatal seal	[ ]	[ ]
Poor oral control/propulsion	[ ]	[ ]
Reduced BOT-PPW approximation	[ ]	[ ]
Reduced pharyngeal contraction	[ ]	[ ]
Reduced hyolaryngeal excursion	[ ]	[ ]
Reduced UES opening	[ ]	[ ]
Early closure of UES	[ ]	[ ]

2. Based on the findings, what is your impression on the possible diagnosis of this patient?
   Severe oropharyngeal dysphagia
   Moderate pharyngeal dysphagia
   Severe pharyngeal dysphagia

3. What diet recommendation would you suggest for the patient?
   A. Normal diet
   B. Thicken liquids
   C. Volume modification
   D. Nil by mouth (except oral pleasure)

4. Which compensatory technique(s) would you choose for the patient?

	Yes	No
Cyclic ingestion	[ ]	[ ]
Thermal-tactile stimulation	[ ]	[ ]
Increase taste-sour bolus	[ ]	[ ]
Head turn/head tilt	[ ]	[ ]

5. Which rehabilitation technique(s) you may choose to the patient?

	Yes	No
Supraglottic swallow	[ ]	[ ]
Super-supraglottic swallow	[ ]	[ ]
Masako Maneuver	[ ]	[ ]
Shaker's Exercise/Chin Tuck Against Resistance (CTAR)	[ ]	[ ]
Mendelsohn Maneuver	[ ]	[ ]

6. Which of the exercise below can be done with and without food?

	Yes	No
Masako manoeuvre	[ ]	[ ]
Chin Tuck Against Resistance (CTAR)	[ ]	[ ]
Effortful swallow	[ ]	[ ]
Mendelsohn Maneuver	[ ]	[ ]
Supraglottic swallow	[ ]	[ ]

APPENDIX M: SUS FORM

Participant ID: _____

System Usability Scale Questionnaire (the ISD)

Please rate the following statement based on your personal opinion and experiences using the interactive self-training system for dysphagia management (ISD).

	Strongly Disagree				Strongly Agree
1. I think that I would like to use the ISD frequently.	1	2	3	4	5
2. I found the ISD unnecessary complex.	1	2	3	4	5
3. I thought the ISD was easy to use.	1	2	3	4	5
4. I think I would need the support of a technical person to be able to use the ISD	1	2	3	4	5
5. I found the various functions in the ISD were well integrated.	1	2	3	4	5
6. I thought there was too much inconsistency in the ISD	1	2	3	4	5
7. I imagine that most people would learn to use the ISD very quickly.	1	2	3	4	5
8. I found the ISD very awkward to use.	1	2	3	4	5
9. I felt very confident using the ISD.	1	2	3	4	5
10. I needed to learn a lot of things before I could get going with the ISD.	1	2	3	4	5

List down 3 positive aspects of the ISD:

_____

_____

_____

_____

List down 3 negative aspects of the ISD:

_____

_____

_____

Recommendation for improvement:

_____

_____

_____

APPENDIX N: IIMS FORM FOR THE ISD

Participant ID:_____

The Instructional Materials Motivation Survey (IMMS) for the ISD

Please rate the following statement based on your personal opinion and experiences using the interactive self-training system for dysphagia management (ISD). Use the scale below to indicate the extent to which you agree or disagree with the statement:

1 - Not true
2 - Slightly true
3 - Moderately true
4 - Mostly true
5 - Very true

Please select the most appropriate number on the scale to indicate your response.

Statement	Score				
	Not true	Slightly true	Moderately true	Mostly true	Very True
1. When I first looked at the ISD modules, I had the impression that it would be easy for me.	1	2	3	4	5
2. There was something interesting at the beginning of these activities that caught my attention.	1	2	3	4	5
3. The modules in the ISD were harder to understand than I would have liked.	1	2	3	4	5
4. After listening to the initial information, I felt confident that I knew what was expected to be learned from this activity.	1	2	3	4	5
5. Completing the modules in the ISD gave me a satisfying sense of accomplishment.	1	2	3	4	5
6. It is clear to me how the content of the ISD is related to knowledge I already have.	1	2	3	4	5
7. Many of the pages in the ISD had so much information that it was hard to pick out and remember the important points.	1	2	3	4	5
8. The ISD materials are interesting.	1	2	3	4	5
9. There were stories, pictures, or examples that showed me how the material could be important for some people.	1	2	3	4	5
10. Successfully completing this activity was important to me.	1	2	3	4	5

11. The quality of the material in the ISD helped to keep my attention.	1	2	3	4	5
12. The modules are so abstract that it was hard to keep my attention on it.	1	2	3	4	5
13. As I worked on this activity, I was confident that I could learn the content.	1	2	3	4	5
14. I enjoyed the ISD so much that I would like to know more about dysphagia management topic.	1	2	3	4	5
15. The pages in the ISD look uninteresting.	1	2	3	4	5
16. The content of the ISD is relevant to my interest.	1	2	3	4	5
17. The way the information is arranged on the pages helped keep my attention.	1	2	3	4	5
18. There are explanations or examples of how people use the knowledge in the module.	1	2	3	4	5
19. The exercises in the ISD were very difficult.	1	2	3	4	5
20. The modules in the ISD have things that stimulated my curiosity.	1	2	3	4	5
21. I really enjoyed studying this activity.	1	2	3	4	5
22. The number of repetitions in the ISD modules caused me to get bored sometimes.	1	2	3	4	5
23. The content and style of writing in the ISD convey the impression that its content is worth knowing.	1	2	3	4	5
24. I learned some things that were surprising and unexpected.	1	2	3	4	5

25. After working on this activity for some time, I was confident that I would be able to pass a test on it.	1	2	3	4	5
26. The modules in the ISD were not relevant to my needs because I already knew most of it.	1	2	3	4	5
27. The way feedback was given after the exercises or other comments on the activity helped me feel rewarded for my effort.	1	2	3	4	5
28. The variety of exercises, images, videos, etc., helped keep my attention to the ISD.	1	2	3	4	5
29. The writing style is boring.	1	2	3	4	5
30. I could relate the content of the ISD to things I have seen, done, or thought about in my own life.	1	2	3	4	5
31. There are so many words on each page that it is annoying.	1	2	3	4	5
32. It was good to successfully complete this activity.	1	2	3	4	5
33. The content of the ISD will be useful for me.	1	2	3	4	5
34. I could not really understand quite a bit of the material in the ISD .	1	2	3	4	5
35. The good organization of the content helped me be confident that I would learn this material.	1	2	3	4	5
36. It was a pleasure working on such a well-planned activity.	1	2	3	4	5

APPENDIX O: IIMS FORM FOR CLASSROOM-BASED TRAINING

Participant ID:_____

The Instructional Materials Motivation Survey (IMMS) for case-based dysphagia training

Please rate the following statement based on your personal opinion and experiences of the case-based dysphagia training. Use the scale below to indicate the extent to which you agree or disagree with the statement:

1 - Not true
2 - Slightly true
3 - Moderately true
4 - Mostly true
5 - Very true

Please select the most appropriate number on the scale to indicate your response.

Statement	Score				
	Not true	Slightly true	Moderately true	Mostly true	Very True
1. When I first looked at the lesson, I had the impression that it would be easy for me.	1	2	3	4	5
2. There was something interesting at the beginning of these activities that caught my attention.	1	2	3	4	5
3. The lessons were harder to understand than I would have liked.	1	2	3	4	5
4. After listening to the initial information, I felt confident that I knew what was expected to be learned from this activity.	1	2	3	4	5
5. Completing the lesson in the training gave me a satisfying sense of accomplishment.	1	2	3	4	5
6. It is clear to me how the content of the training is related to knowledge I already have.	1	2	3	4	5
7. Many of the pages had so much information that it was hard to pick out and remember the important points.	1	2	3	4	5
8. The materials are interesting.	1	2	3	4	5
9. There were stories, pictures, or examples that showed me how the material could be important for some people.	1	2	3	4	5
10. Successfully completing this activity was important to me.	1	2	3	4	5

11. The quality of the material helped to keep my attention.	1	2	3	4	5
12. The lesson is so abstract that it was hard to keep my attention on it.	1	2	3	4	5
13. As I worked on this activity, I was confident that I could learn the content.	1	2	3	4	5
14. I enjoyed the case-based dysphagia training so much that I would like to know more about dysphagia management topic.	1	2	3	4	5
15. The pages in the lesson look uninteresting.	1	2	3	4	5
16. The content of the case-based dysphagia training is relevant to my interest.	1	2	3	4	5
17. The way the information is arranged on the pages helped keep my attention.	1	2	3	4	5
18. There are explanations or examples of how people use the knowledge in the training.	1	2	3	4	5
19. The exercises in the case-based dysphagia training were very difficult.	1	2	3	4	5
20. The lessons in the case-based dysphagia training have things that stimulated my curiosity.	1	2	3	4	5
21. I really enjoyed studying this activity.	1	2	3	4	5
22. The number of repetitions in the case-based dysphagia training caused me to get bored sometimes.	1	2	3	4	5
23. The content and style of writing in the case-based dysphagia training convey the impression that its content is worth knowing.	1	2	3	4	5

24. I learned some things that were surprising and unexpected.	1	2	3	4	5
25. After working on this activity for some time, I was confident that I would be able to pass a test on it.	1	2	3	4	5
26. The lessons in the case-based dysphagia training were not relevant to my needs because I already knew most of it.	1	2	3	4	5
27. The way feedback was given after the exercises or other comments on the activity helped me feel rewarded for my effort.	1	2	3	4	5
28. The variety of exercises, images, videos, etc., helped keep my attention to the case-based dysphagia training.	1	2	3	4	5
29. The writing style is boring.	1	2	3	4	5
30. I could relate the content of the case-based dysphagia training to things I have seen, done, or thought about in my own life.	1	2	3	4	5
31. There are so many words on each page that it is annoying.	1	2	3	4	5
32. It was good to successfully complete this activity.	1	2	3	4	5
33. The content of the case-based dysphagia training will be useful for me.	1	2	3	4	5
34. I could not really understand quite a bit of the material in the case-based dysphagia training.	1	2	3	4	5

35. The good organization of the content helped me be confident that I would learn this material.	1	2	3	4	5
36. It was a pleasure working on such a well-planned activity.	1	2	3	4	5