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**Developing a Comprehensive Framework
To Enhance Technology-Based Formative Assessment Practice
in Higher Education Courses**

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Statement of Originality

This is to certify that to the best of my knowledge, the content of this thesis is my own work.

This thesis has not been submitted for any degree or other purposes.

I certify that the intellectual content of this thesis is the product of my own work and that all the assistance received in preparing this thesis and sources have been acknowledged.

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“The journey of a thousand miles begins with a single step.” - Lao Tzu

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Dedicated to the loving memory
of
my mother

Abstract

The use of technology is increasingly now part and parcel of higher education institutions. This has led to a greater reliance on technology for educational assessment. However, lecturers are faced with the challenges of implementing and developing assessments that truly inform teaching and the learning process in 21st century education, particularly formative assessment. Formative assessment is often neglected or poorly implemented in higher education. This is despite the fact that formative assessment is crucial for effective teaching and learning, as well as for students' lifelong development. While formative assessment happens naturally during daily teaching practice, it is most important to make sure that it is applied effectively and consistently to gauge students' understanding, collect timely data and inform instruction in meaningful, sustainable, and scalable ways.

By using a mixed methods approach, this thesis determines the amount and effectiveness of formative assessment and associated technologies being conducted in a higher education institution in Oman, and builds and validates a measurement rubric. The rubric was devised and served to ascertain the effectiveness of formative assessment practice informed by technologies, and to enable and monitor any changes in such practice after undertaking a professional development (PD) program. The findings revealed that the participants initially had limited understanding and inconsistent practice of formative assessment and associated technologies. Nonetheless, they showed significant improvement in their understanding and practice after the PD program.

A major contribution is that a measurement rubric, with supporting evidence, can measure the effectiveness of formative assessment practice informed by technologies. This makes it possible to identify the current location of a lecturer's practice and then use this information to determine the next improvement stage based on the rubric's proficiency levels descriptors. If used as a roadmap, it provides direction to good practice and improvement. If used collectively and widely (at an institution) it can potentially create equitable conditions

for all students to receive the best possible formative assessment experiences. This thesis also contributes to the growing body of literature by providing empirical evidence on the impact of the developed PD on lecturers' understanding and practice.

The findings documented in this thesis have important implications for professional development providers and policymakers on how to empower lecturers with instructional support to effectively implement formative assessment practice and associated technologies in higher education courses, in Oman and internationally. Suggestions for future research are made regarding the use of robust research methods, and giving more attention to the validity and reliability of the measurement rubric and a closer focus on its use in diverse higher education contexts. These endeavours will ultimately lead to better teaching and learning quality which is a key priority for policymakers and stakeholders in higher education.

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Abbreviations

AfL	Assessment for Learning
AoL	Assessment of Learning
ELC	English Language Centre
EFL	English Foreign Language
FA	Formative Assessment
HEIs	Higher Education Institutions
HREC	Higher Research Ethics Committee
OAAA	Oman Academic Accreditation Authority
OER	Open Educational Resources
PD	Professional Development
SRS	Student Response System
TBFA	Technology-Based Formative Assessment
TPACK	Technological Pedagogical Content Knowledge
UTAS	University of Technology and Applied Sciences
ZPD	Zone of Proximal Development

Glossary

Components: are the skills, knowledge, and/or behaviours to be measured. They describe what should be demonstrated or achieved in relation to the construct or outcome.

Differentiation: is a teaching approach that aims at adjusting instruction to meet the individual needs of students.

Formative assessment: is an ongoing process in which various tools and strategies, planned or unplanned, used during the learning process to provide lecturers and students with feedback so teaching and learning can be adjusted to close the gap between current learning and desired goals.

Feedback: is information that describes a student's strengths, weaknesses, and needs, providing the student with the opportunities to improve his or her current level of understanding.

Indicators: are the specific skills or knowledge that fall under each component of the measurement rubric.

Instructional adjustments: are making certain changes during instruction based on feedback information.

Measurement rubric: is a set of components that describe growth in terms of increasing levels of proficiency with reference to the construct or outcome to be measured.

Proficiency descriptors: are the statements that describe the characteristics of each level of proficiency for each component.

Professional development: is a set of tools, resources, and training sessions that are specifically designed for lecturers to impact their teaching practices and improve the quality of their teaching.

Scaffolding: is the support that students receive from teachers or peers to help them bridge the gap between what they know and what they need to know.

Student Response System (SRS): is an interactive technology that allows lecturers to rapidly collect and analyse students' responses to questions.

Summative assessment: is a type of assessment that requires making evaluative judgments against standardised criteria about what has been learned at the end of a unit of a study or an end of a semester or an academic year.

Technology-Based Formative Assessment: is the use of digital tools and platforms to collect, analyse and facilitate the provision of feedback in the context of formative assessment.

The levels of proficiency: these are the ratings that indicate improvement in performance.

Zone of Proximal Development (ZPD): is a concept developed by Lev Vygotsky that describes the gap between what a student can do without help and what they can do with help given by a teacher or peer.

Chapter 1: Introduction

1.1 Context of the Thesis

Educational assessment has an important role to play in the teaching and learning process. According to Palomba and Banta (1999), educational assessment is “the systematic collection, review, and use of information about educational programs undertaken for the purpose of improving student learning and development” (p. 4). It is essential for measuring and evaluating the learning outcomes, skills, and knowledge of students in higher education (Pitt & Quinlan, 2021). Assessment lies at the heart of formal higher education (Gikandi et al., 2011) and it frames students’ opinions of higher education (Boud & Falchikov, 2007).

Although there are various classifications of educational assessments, summative and formative assessment are two types that are widely discussed in the context of education. In recent times in higher education, there has been a shift from traditional testing of knowledge towards using assessment for the purpose of learning (Dochy et al., 2006). This shift involves a move away from using assessment mainly to measure student performance to using assessment to support and enhance students’ learning (Dochy et al., 2006). In other words, formative assessment should be emphasised in higher education (Winstone & Boud, 2022; Boud & Falchikov, 2005; Rawlusk, 2018). Formative assessment is an ongoing process that allows lecturers to help their students to know what to do to move from their current position to the desired learning goals. It is primarily about using feedback information to modify teaching and learning activities to meet future needs (Bennett, 2011; Black & Wiliam, 1998a; Black & Wiliam, 1998b; Sadler, 1989).

There is no doubt that formative assessment is particularly important in higher education. One of the tacit aims of higher education is to shape tomorrow’s professionals. Williams

(2020) makes the point that higher education creates opportunities for students to increase their knowledge and foster their skills for later use in their career of choice. Education in the 21st century requires students to master certain skills for both social and career contexts. These skills include, but are not limited to, reasoning, cognition, problem-solving, and learning to learn. Boud and Flachikove (2007) stated that the emphasis on feedback, self- and peer-assessment (characteristics of formative assessment) can enhance the after-graduation learning needed in a knowledge-based economy. Additionally, the shift from teacher-centred to more student-centred teaching and learning at universities requires new assessment practices that are based on both students and lecturers becoming responsible partners in learning and assessment (Boud, 2013b). This emphasis a need to implement formative assessment effectively and consistently to attain higher education aims.

Numerous studies have highlighted the importance of formative assessment to inform teaching and learning (Andersson & Palm, 2017; Baird et al., 2014; Cornelius, 2014; Filsecker & Kerres, 2012; Hudesman et al., 2013; Madison-Harris & Muoneke, 2012; Yin et al., 2013, as cited in Kenyon, 2019). Formative assessment has also been shown to be effective in developing students' learning at the tertiary level (Koka et al., 2017).

Despite the immense potential of formative assessment, it is not widely practiced or implemented effectively in higher education contexts (Boud et al., 2018; Hurton, 2019) and providing feedback is insufficiently employed in the teaching structure of today's universities (Booth & Hyland, 2000, as cited in Duss, 2020). Too often, educational assessment in higher education is seen in terms of summative assessment that is used primarily for the purpose of assigning grades or evaluating student progress at the end of a unit of study and has been the dominant assessment form in higher education (Bahati, 2019; Brown et al., 2016). There is much debate in the literature regarding whether a test at the end of the course or a unit of study can accurately depict students' knowledge of the content or not (Harlen, 2005, as cited

in Davis, 2017). It has been found that providing such feedback at the end of the course is not as effective as descriptive feedback that diagnoses strengths and weaknesses with recommendations for future actions to improve students' performance (Brown et al., 2016). As well, Boud and Falchikov (2007) stated that lecturers have failed to prepare students for the rest of their lives.

There are great challenges in higher education institutions to the implementation of formative assessment practice. One of the challenges is that higher education has been characterised by a high ratio between students and lecturers (Fortes & Tchantchane, 2010). As student numbers and class sizes become larger, the workload of lecturers in higher education increases (Koç et al., 2015). It is also important to note that having a large number of students may limit the interaction between them and their lecturers. Little interaction can lead to limiting the amount of feedback provided to students (Cuseo, 2007, as cited in Duss, 2020). Miller (2009) claimed that it is not possible for lecturers to meet the needs of individual students and guide their learning in undergraduate classes that consist of hundred students. As a result, formative assessment practices in higher education have not been widely practised.

Difficulties in defining formative assessment is one of the reasons beyond the paucity in formative practice in higher education (Hurton, 2019). Havnes et al. (2012) argued that a limitation of the use of formative assessment in higher education is due to the confusion as to what exactly formative assessment looks like in practice. Bahati (2019) stated that the efforts made in higher education to practice formative assessment are hindered by several factors that lead to poorly defined practices. Earl (2013) asserted that it is not only inconsistent use of formative assessment but also inaccurate use of it.

Furthermore, there is a lack of evidence to support the effectiveness of formative assessment and feedback in higher education (Boud & Molloy, 2013; Morris et al., 2021).

Most of the research demonstrating the benefits of formative assessment is related to the school sector (Morris et al., 2021). Morris et al.'s (2021) systematic review of the literature discovered that most studies on formative assessment in higher education are descriptive, qualitative, or correlational and do not provide casual evidence of its impact. Morris et al. (2021) also found that the research on formative assessment was conducted in small-scale studies, and there was a need for more large-scale, rigorous trials to determine the true effectiveness of this approach. What compounds this problem is a scarcity of theoretical and pedagogical studies that explore formative assessment from the perspectives of students and faculty in higher education (Ma et al., 2023).

There are several possible explanations for the lack of evidence of formative assessment effectiveness in higher education. One possibility is that the nature of learning in higher education is more complex and challenging than in schools. This is because higher education is not just about measuring student learning, but also about preparing students for the demands of the workplace (Boud & Falchikov, 2007; Hattie, 2012). Another substantial challenge in the field of formative assessment is the lack of appropriate instruments for assessing the practice of this kind of assessment (Yan & Pastore, 2022). This is because there is no consensus on what can be counted as formative assessment practice (Yan & Pastore, 2022). Lyon et al. (2020) also noted that there is a lack of instruments with sufficient technical quality that focuses on how effectively classroom formative assessment is applied.

It is important to note that there are certain consequences of not having a suitable instrument for assessing the effectiveness of formative assessment practice. First, it is difficult to understand and describe the effectiveness of lecturers' formative assessment practice and, this subsequently, makes it less likely to have targeted intervention programs. Second, without an appropriate instrument to assess formative assessment practice, it is

difficult to know the efficacy of professional development intervention in enhancing formative assessment practice (Yan & Pastore, 2022).

This view of formative assessment, its challenges, and its limited practice as argued above, captures the actual situation in Oman as well. AlKharusi et al. (2014) stated that educational assessment in Oman has been characterised by the use of formal examinations (summative assessment). For instance, mid-term and end-of-semester examinations are the dominant measures of student achievement in Oman (Denman & Al Mahrooqi, 2018). The stimulus for this thesis is the need to have lecturers upgrade their understanding and use of effective formative assessment processes with the aim of improving student learning in higher education.

It is not an easy task to conduct formative assessment in a way that produces the rewards in student learning outlined in the research. According to Alzaid and Alkarzae (2019), paper-based formative assessment has several difficulties in being implemented in a way that meets the learning needs of students. For instance, it is difficult to provide multiple and individualised assessment opportunities in a short time span with paper-based methods. It is also difficult to provide each student with instant and effective feedback, which is essential for enhancing students learning outcomes (Alzaid & Alkarzae, 2019). The solution could lie in integrating technology into formative assessment practice.

There has been a growing realisation that technology potentially provides avenues to transform teaching and learning when it is used with assessments. When technology is used for formative assessment, it provides students with appropriate feedback to guide their learning as well as informs teaching (Admiraal et al., 2020). As cited in Bahati (2019), the process of using technology to enable and facilitate the provision of feedback in the context of formative assessment is referred to as formative e-assessment (Pachler, Daly, Mor, & Mellor, 2010; Pachler et al., 2009) or online formative assessment (Gikandi et al., 2011; Koç

et al., 2015; Baleni, 2015). It can also be called online, web-based, or computer-based formative assessment, depending on the type of technology used (Costa, Mullan, Kothe, & Butow, 2010; Henly, 2003; Peat & Franklin, 2002; Bull, Quigley, & Mabbott, 2006; Timmers, Braber-van den Broek, & van den Berg, 2013, as cited in Bahati, 2019). Another terminology for it is technology-enhanced formative assessment (Beatty & Gerace, 2009; Spector et al., 2016), or technology-based formative assessment (Alqurashi & Siegelman, 2019; Elmahdi et al., 2018). Technology-based formative assessment (TBFA) is the terminology that is used in this thesis. It refers to the use of digital tools and platforms to collect, analyse, and facilitate the provision of feedback in the context of formative assessment. TBFA can provide invaluable learning experiences and helpful features that lecturers can utilise to make the most of class time and address the needs of all students (Alqurashi & Siegelman, 2019).

It is worth noting here that the recent COVID-19 pandemic disrupted teaching and learning systems, both locally and globally. It triggered a shift from face-to-face teaching and learning to online teaching. This unprecedented move forced higher education institutions to seek available online platforms to continue teaching digitally. Moodle and MS Teams were the online platforms used by the lecturers at the University of Technology and Applied Sciences (UTAS-Ibri) in Oman to maintain the teaching and learning processes during the COVID-19 pandemic. Moodle was formerly integrated into various higher education institutions in Oman and showed that it is a worthwhile approach in both e-learning and blended learning environments (Ahmad & Al-Khanjari, 2012). MS Teams is a relatively new experience for both lecturers and students as stated by this study's participants. However, technology alone cannot guarantee effective and consistent formative assessment practice. Lecturers need to have a more nuanced understanding of formative assessment practice and

its purposes, as well as the skills and knowledge to use technology appropriately and effectively.

In the face of these difficulties, lecturers need to find and implement ways to overcome the nominated challenges and meet students' needs. Lecturers need to conceptualise the fundamental issues related to formative assessment. These issues include understanding of formative assessment practice in relation to serving its intended purposes, understanding how formative assessment functions with the aid of technology, as well as finding a mechanism for measuring the effectiveness of formative assessment practice.

Given the focus on formative assessment and given the increased role and importance of technology in higher education, it is the intention of this thesis to examine not only how much lecturers use formative assessment in a contained unit of study in a university in Oman, but also how well they use it. As well, given the increased role and importance of technology in higher education in Oman and more globally, the intention is to view formative assessment through a technology lens and in doing so, encourage the use of innovative technologies in the formative assessment process. The link between formative assessment and pedagogy, when enhanced by technology creates an opportunity for lecturers in Oman and more broadly to use targeted instructional support in higher education classrooms to enhance the teaching and learning process.

1.2 Purpose of this Thesis

It has been observed that there is a paucity of practice among lecturers regarding the use of formative assessment in Oman. AlKharusi et al. (2014) revealed that the Omani educational assessment system has been linked with formal examinations especially high-stakes standardised tests. In the same vein, Cambridge and the CFBT/NFER study (2012, as cited in Al Shabibi & Silvennoinen, 2018) pointed out that the assessment system in Oman rely heavily on summative assessment. This overemphasis on summative assessment such as

standardised tests scores has led to a lack of focus on formative assessment (Baker, 2007; Ecclestone, 2010; Harlen & Deakin Crick, 2002; Sadler & Good, 2006, as cited in Spector et al., 2016). It is also worth noting that generally the purpose of summative tests is focused on accountability and there is very little attempt to use the results of the tests to do anything other than rank-order students for the purpose of grading and selection. Boud and Falchikov (2007) noted that there is a serious problem that needs to be addressed if grading and classification are the dominant focus of assessment.

Al-Amri (2011) investigated the assessment techniques utilised in teaching art at Sultan Qaboos University, Oman. He found that students do not receive immediate support and guidance on their work, and furthermore they are unaware about the system and criteria used for assessing their work. This suggests that there may be gaps in lecturers' understanding and practice of formative assessment in Oman. Formative assessment is considered both a practice and a process centred on the idea of feedback loops and its impact is dependent upon on the feedback provided to both students and lecturers. In the higher education context, Boud and Flachikove (2007) illustrated that well-crafted feedback can promote accelerated learning, optimise the quality of what is learned and raise individual and collective attainment.

While feedback is critical to the implementation of formative assessment, a significant number of studies in higher education have highlighted the inadequacy of feedback provided to students. According to Boud and Flachikove (2007), three consecutive quinquennial surveys by Krause et al. (2005) have disclosed dissatisfaction with the adequacy of feedback provided for undergraduate students. In the same vein, surveys in Hong Kong by Carless (2006) revealed that students are unhappy with the quality of feedback provided to them because it does not contribute to improving their performance (Boud & Flachikove, 2007).

As noted previously, lecturers in higher education devote most of their time to summative assessment methods such as exams, projects, or final papers (Grier et al., 2021). Gibbs et al. (2005, as cited in Wanner & Palmer, 2018) argued that lack of resources in conventional universities has significantly affected the decline of formative assessment practices. Consequently, it is necessary to find an appropriate method to collect and analyse students' responses in real-time as well as provide them with well-crafted feedback that has the potential to improve their learning.

Countless interactive platforms are currently in use, and their effectiveness in the education field have been documented. According to Johnson et al. (2014), the recent trend in education has sought to integrate technologies that use analytical data to adjust learning strategies and processes as needed. Technology provides a significant contribution to the different stages of assessment (Neumann et al., 2019). Because of the capacity of the technology in obtaining and processing extensive data, the workload associated with the successful implementation of formative assessment practice would be less (Dalby & Swan, 2019; Ningsih & Mulyono, 2019, as cited in Luthfiyyah et al., 2021).

Technology can potentially play a crucial role in supporting formative assessment practice in various ways. In this regard, lecturers can utilise some of the currently available technology tools, such as the student response system (SRS). SRS is a computer-assisted polling tool (Pond, 2010), that provides students with anonymity and lecturers with instant access to a collection of data, and the ability to share visual representations of students' responses that help enhance recognition (Roshelle, 2003, as cited in Liu, 2010). Lecturers in this case can easily track students' progress, know exactly what their needs are and make informed instructional adjustments. SRS makes possible just-in-time adjustments at any given time in the teaching process.

Implementing SRS formatively also offers valuable opportunities for effective collaboration between lecturers and students. It should be noted that SRS technologies are now equipped with new array of features and interwoven generative artificial intelligence (AI) such as Kahoot! (Kahoot!, 2023).

Many researchers have dealt with the effectiveness of formative assessment in student learning. However, only a limited number of studies have shed light on the impact of using the student response system (SRS) results for formative assessment. It could be that this issue has not been sufficiently investigated so far, particularly in Oman. However, little is known about how technology-based formative assessment is formulated in the Omani context and the role lecturers play in its implementation or otherwise.

Another important point to consider is that at the time of this writing, various Higher Education Institutions (HEIs) in Oman are in the process of seeking institutional or/and academic programs accreditation. To be accredited, these institutions are required to meet the relevant standards that are set by the Oman Academic Accreditation Authority (OAAA) and benchmarked against standards applied by other international accreditation agencies. Each standard consists of a broad area of activity and each has several distinct criteria. Student assessment is one of the essential criteria crafted in the quality assurance mechanism. In the *Institutional Standards Assessment Manual* (2016) which is developed by OAAA.

Criterion 2.8 highlights the importance of having procedures, policies and regulations that govern all aspects of assessment. Criterion 2.8 has different indicators that are related to “Assessment Methods, Standards and Moderation”. For instance, indicators c and f sequentially state that “*Assessments are effective in measuring student achievement of learning outcomes*” and “*The HEI requires that feedback on performance and results of assessment are constructive, timely, and where required, linked to mechanisms for student learning support*” (p. 37).

Doubtless, high-quality teaching and learning is promoted and enriched by well-crafted assessment systems. Al-Mahrooqi et al. (2015) suggested that without implementing such systems, the outcomes of higher education institutions will not be measurable against the identified criteria. These are serious issues, not only in Oman, but also around the globe. What is seemingly absent from the field of formative assessment literature is how higher education institutions can provide a practical guide to help improve lecturers' understanding and practice of formative assessment and associated technologies. Additionally, there is a scarcity of validated tools and frameworks that can measure and enhance technology-based formative assessment practice in higher education (Boud & Falchikov, 2007; Reddy & Andrade, 2010).

This thesis seeks to address this gap in our knowledge by conducting a systematic literature review and a mixed methods study to explore the current state of lecturers' understanding and their level of application of formative assessment practice and associated technologies in a higher education institution in Oman. Hence, the ultimate purpose here is to provide a mechanism for improving and measuring the effectiveness of lecturers' formative assessment practice informed by technologies. It proposes to develop a measurement framework to assess the effectiveness of formative assessment informed by technologies.

This framework is represented as a measurement rubric that can measure a wide range of performance and link it to specific proficiency levels that are not usually found in conventional learning progressions. In other words, the measurement rubric provides lecturers with an explicit description of what good practice in formative assessment looks like and makes them aware of what might need to do to improve their practice. Additionally, it allows lecturers to demonstrate evidence about what they know and are able to do against pre-determined components that combine to define formative assessment and assess themselves against the levels of proficiency explicated in the measurement rubric.

This measurement framework offers a perspective on the implementation and measurement of formative assessment and associated technologies in the higher education context, with potential applications in Oman and beyond.

1.3 Aims and Significance of the Thesis

One of the aims of this thesis is to determine how much formative assessment is being carried out in the English Language Centre (ELC) at the University of Technology and Applied Sciences (UTAS-Ibri), Oman and how technology is used to support this practice. A second aim is to determine how well lecturers in this Centre use formative assessment and associated technologies in their teaching practices. The third aim is to ascertain the extent to which a professional development (PD) program targeted at improving the understanding and practice of technology-based formative assessment in the higher education context can lead to improved understanding and practice of formative assessment.

The challenges associated with achieving the above-mentioned aims require an investigation of lecturers' current understanding and practice of formative assessment and associated technologies. In this thesis, this investigation will be conducted using semi-structured interviews and classroom observations. The results of this study can then be used to develop a professional development (PD) program to guide and enhance lecturers' understanding and use of formative assessment practice informed by technologies. This approach will also require the development of a measurement rubric that will be used during classroom observations to provide evidence as to how well these lecturers use formative assessment and associated technologies in their classroom practices prior to and after receiving the PD program. Furthermore, it will inform the PD program that will be used as a treatment in this research project to help lecturers in the study better implement formative assessment practice informed by technologies. The effectiveness of the PD program is sought

through examining the extent to which it improves lecturers' understanding and practice of formative assessment and associated technologies.

This thesis is significant because it addresses a gap in the literature and addresses what has been identified as a significant inhibitor to the implementation of formative assessment in higher education. It aims to contribute to the field of formative assessment in higher education by developing a measurement framework, represented as a measurement rubric, to measure the effectiveness of formative assessment practice informed by technologies in higher education courses. The framework will be informed by empirical evidence from a specific context and will provide practical and instructional guidance to equip lecturers with foundational knowledge of formative assessment classroom-level strategies. It will also measure growth in the effective use of technology-based formative assessment (TBFA).

The measurement rubric can be used not only for self-evaluating lecturers' own practice but also for peer assessment. It could also help to effectively close any gaps in lecturers' inconsistent and inefficient implementation of formative assessment practice and associated technologies. Ultimately, this measurement framework, represented as a measurement rubric, can also be used to inform policymakers, curriculum developers, and other stakeholders in higher education who want to promote formative assessment as a key component of quality teaching and learning in higher education.

The PD program is essential to support lecturers adopting and adapting technology-based formative assessment (TBFA) in their own contexts. It will help lecturers understand the theoretical foundations and practical implications of TBFA.

1.4 Research Questions

To address the above aims, the thesis sought to answer the following questions:

1. What are the key components of effective formative assessment practice informed by technologies?
2. How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?
3. How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?
4. To what extent do lecturers who have undertaken a Professional Development program targeting technology-based formative assessment (TBFA) improve their understanding and practice of using TBFA in the classroom?

The first question seeks to identify the key components of effective formative assessment practice informed by technologies. Question 2 is designed to primarily explore and analyse the extent of formative assessment informed by technologies practice at a higher education institution in Oman. The third question addresses the issue of the effective use of formative assessment practice informed by technologies in higher education classrooms. The fourth research question directly addresses the impact of the targeted PD program on how well lecturers in this sample eventually use TBFA in their teaching programs.

To answer these questions, the thesis adopts a mixed methods approach. It consists of four stages. Stage 1 focuses on the development and validation of the measurement rubric. Stage 2 determines the current understanding and practice of formative assessment and associated technologies. Based on the findings of the second stage, Stage 3 designs and conducts a professional development (PD) program to enhance lecturers' knowledge and skills of formative assessment and technology use. Stage 4, the final stage, examines the lecturers' change in understanding and practice of formative assessment practice informed by technologies after participating in a professional development (PD) program targeting

technology-based formative assessment. The data analysis methods include thematic and content analysis.

1.5 Summary of Chapters to Follow

This introductory chapter has provided an overview of the thesis and the topic it explores. It outlines the motivation and need for developing a measurement framework to assess the effectiveness of formative assessment practice informed by technologies. It also lists the research questions that guide the thesis. The significance of the thesis is stated and arguments as to why this thesis is imperative are highlighted. This chapter also describes how the thesis can contribute to the articulation of the measurement framework, the development and validation of a measurement rubric, as well as build and deliver a professional development program to lecturers that can positively assist their formative assessment practices.

Chapter 2 provides a comprehensive review of the literature relating to technology-based formative assessment in higher education. The review covers the historical trajectory of formative assessment, provides a precise definition of formative assessment, sheds light on formative assessment benefits, challenges, and the role of technology in supporting it. Also discussed here is the distinction between assessments in schools and higher education, and the difference between summative and formative assessments. It provides an overview of rubrics and validity aspects. Chapter 2 concludes with a description of the Omani higher education system.

This is followed by Chapter 3 which provides a discussion on the theoretical and conceptual formative assessment framework used to guide this thesis. Then, Chapter 4 outlines the methods used for this research project. It shows the nature of the data collected and provides a rationale for the methodology used. Provided here is an overview of the mixed

methods approach in answering the stipulated research questions. This chapter describes the data collection procedures and presents data analyses for each stage of the research.

Chapters 5, 6, and 7 present the findings of the data collected within four stages and introduce the identified themes that are presented as a response to the research questions. These chapters are explained in more detail below.

Chapter 5 shows a basis for developing a measurement rubric for assessing the effectiveness of formative assessment practice informed by technologies. It describes how to build measurement rubrics, discusses the procedures and steps used in constructing the draft measurement rubric, and shows the results of a content validation process for validating the draft of the measurement rubric. The chapter also presents the findings of the focus group to refine and validate the measurement rubric.

Chapter 6 deals with the findings from the initial interviews and classroom observations that examined the participants' prior understanding and practice of formative assessment and associated technologies. Then Chapter 7 discusses the lecturers' understanding and practice of improved or increased technological and pedagogical knowledge after their participation in the professional development program. It reports the findings from Stage 4, the interviews and classroom observations conducted toward the end of the study.

Chapter 8, the final chapter, concludes this thesis by discussing each of the research questions in relation to the findings generated from the data collection stages. The chapter also identifies the key implications and directions for future research to support the effective and consistent implementation of formative assessment practice and associated technologies in higher education contexts.

Chapter 2: Literature Review

2.1 Introduction

This chapter comprises a comprehensive review of the literature that aims at providing in-depth relevant information regarding technology-based formative assessment in the higher education context. It describes the historical tracing of formative assessment over time and its conceptualisation. This is followed by evidence supporting the effectiveness of technology as a tool to facilitate the practice of formative assessment. Then, the pedagogical practices, skills and knowledge needed to effectively and consistently implement formative assessment supported by associated technologies within the context of the current study, are outlined. Following that, the chapter examines the relevant literature on how and why professional development can be of crucial importance to support the practice of formative assessment. It also explores relevant literature on the validation of measurement rubrics. The chapter concludes with a brief overview of the Omani higher education and its secondary feeder system.

2.2 Assessment in Higher Education

In education contexts, the terms “assessment” and “testing” are often used interchangeably. Hughes (2003) defines a test as “just one form of assessment” (p. 5). According to Brown and Abeywickrama (2010), a test is a specific assessment or a particular form of assessment. Mihai (2010) stated that assessment is “much more than tests and test scores” (p. 22). The word “assess” comes from the Latin verb “assidere” which means “to sit with”. Literally, assessment, in an educational context, means the lecturer sits with the learner. Assessment is something lecturers do *with* and *for* the student but not *to* the student (Green, 1998). Assessment is “a central feature of teaching and the curriculum” (Boud, 2013, p. 1). It is “the collection of information for a purpose” (Tognolini & Davidson, 2013, p. 23).

To illustrate, assessments are used for the purpose of improving students' learning, monitoring their progress, and certificating their performance or achievement (Tognolini & Stanley, 2007). Assessment "involves professional judgement based upon an image formed by the collection of information about student performance" (Tognolini & Stanley, 2007).

In a broad sense, Brown (2018) defined assessment as "the set of methods and processes by which evidence about student learning is designed, collected, scored, analysed, and interpreted" (Brown, 2018, p. 1).

There are also other terms associated and closely related to assessment such as "evaluation" and "measurement" (Ghaicha, 2016). Tognolini and Shakra (2021) made a distinction between evaluation and measurement. Evaluation is the process of providing a summary of the information (shown in the image) by using a grade, comment or a mark that reflects a value judgment about the image (it is good or bad; it deserves an A; it is a high distinction; etc.). Measurement is defined as the process of assigning a number to the performance to indicate the position along the development continuum that underlies the performance (sometimes known as a progression) (Tognolini and Shakra, 2021, p. 16).

Since this thesis is primarily concerned with higher education, it is crucial to make a distinction between assessments at school levels and in higher education. The systematic review by Morris et al. (2021) suggested that the aims of teaching and learning are one of the key differences between assessments in schools and higher education. Wilson et al. (2017) found that style, structure, and diversity of assessment are different in schools and higher education. Wilson et al. (2017) further explained that assessment at upper secondary is typically at large scale (generally system-level) and subject to strict regulatory requirements compared to assessment at the university level. School teachers are under strong accountability measures as they are required to focus on maximising students' grades whereas the university lecturers are not subject to such strong accountability measures.

Doubtless such differences impact assessment choices and practices as well as influence students' experiences. Bloxham and Boyd (2007) noted that assessment in higher education shapes students' experience and their behaviour more than the teaching they receive. It influences students' learning and shapes their directions for development.

It is important, therefore, to note that this thesis will concentrate on formative assessment in higher education, but will revert to school assessments when required to clarify points or refer to lessons that could be beneficial to consider in the context of assessment in higher education.

2.3 Distinction between Summative and Formative Assessment

To have a precise definition of formative assessment, it is vital to make a distinction between formative and summative assessments. Assessment has often been divided into two broad categories based on different roles and purposes: summative and formative. While each one has a different purpose, both inform decisions about student learning (Koç et al., 2015). The distinction between their purposes was first introduced by Michael Scriven (1967) in the context of program evaluation (Black & Wiliam, 2003; Wiliam & Thompson, 2008; Bennet, 2011). Scriven (1967) referred to aspects of course revision as “formative” and the final evaluation as “summative”. According to Scriven (1967), formative evaluation was a rational part behind producing good results on summative evaluations. Scriven (1967) regarded evaluation as formative if the information gathered, while a program is still in the planning and developmental stages, contributed to changes in the program. Conversely, if the implemented program has met its intended goals when the information is used, it is considered as summative. Scriven (1967) described summative assessment practice as a method to determine next steps in attempting to meet students' needs to pass the academic year. In contrast, he used the term formative assessment to describe the data collection process carried out during the implementation of a program.

Shortly after Scriven (1967), Bloom (1968) made a similar distinction but with respect to students. Bloom (1968) described summative assessment as an examination that is designed for the purposes of grading and curriculum evaluation. Andrade and Cizek (2010) considered an assessment to be summative if it meets the following two criteria: “(1) it is administrated at the end of some unit of instruction” and (2) “its purpose is primarily to categorise the performance of a student or system” (p. 3). To illustrate, the main purpose of summative assessment is to obtain a measurement of achievement employed for a specific purpose, for instance, assigning grades, awarding a degree, and making promotion or retention decisions (Andrade & Cizek, 2010). In contrast, formative assessment is a way to measure students’ progress to ensure a mastery of a learning goal (Davis, 2017; Bennett, 2011).

In summary, formative assessment serves to make judgments about students’ progress and then these judgments are used to influence the subsequent flow of instruction. Thus, it is designed to assist learning and it is connected to the next step of instruction (Heitz, 2013). Formative assessment is about forming learning (Brookhart, 2013). In contrast, the emphasis of summative assessment is on forming judgments on how well students do at the end of an instructional sequence. It is administrated after the learning has taken place (Bloom et al., 1971, as cited in Hurton, 2019).

2.4 History of Formative Assessment

The term “formative” was first introduced by Michael Scriven (1967) in connection with the improvement and evaluation of the school curriculum. According to the author, “Formative evaluation involves the collection of appropriate evidence during the construction and trying out of a new curriculum in such a way that revision of the curriculum can be based on this evidence” (Scriven, 1967, p. 63). Benjamin Bloom (1968) proposed the idea of connecting summative and formative evaluations to the teaching and learning context. He

then began to explore how formative evaluation processes could in fact assess student learning. Bloom (1968) viewed formative evaluation as “brief tests used by lecturers and students as aids in the learning process” and argued that “we see much more effective use of formative evaluation if it is separated from the grading process and used primarily as an aid to teaching” (p. 48). He referred to this process of formative assessment as “mastery learning” (Bloom et al. 1971, p. 45).

According to Bloom et al. (1971), the concept of formative assessment achieved recognition in the education field with the publication of *Handbook for Formative and Summative Evaluation of Student Learning*. Bloom et al. (1971) expanded on Scriven’s definition of formative evaluation and conceptualised it as the “systematic evaluation in the process of curriculum construction, teaching, and learning for the purposes of improving any of these three processes” (p. 118). They also developed the idea of feedback and correctives that help students to identify what they know and what they needed to know better. In other words, Bloom et al. (1971) stressed that lecturers should incorporate formative assessment in their teaching methods. In 1984, Bloom broadened the strategy of “mastery learning” by examining student learning under different conditions. The study revealed that students who were taught using mastery learning scored higher than the control group, who were taught using standard lectures and summative assessments. Assessment, feedback, correctives, and enrichment activities are the major constructs of Bloom’s work that have become major components of formative assessment (Heitz, 2013).

Over the next decade, a substantial number of studies supported the use of formative assessment to improve student performance on standardised tests (Fiel & Okey, 1974; Green, 1975; Block & Burns, 1976, as cited in Harris, 2016). The bulk of the literature available on formative assessment in the 1980s concentrated on the process of formative assessment and stressing the importance of feedback to students as a crucial part of the formative assessment

process (Berliner, 1980; Natrielo, 1987; Crooks, 1988, as cited in Harries, 2016). As well as feedback, other constructs like questioning and motivation were considered as characteristics of formative assessment practice. According to Heitz (2013), several studies were conducted in the 1980s to clarify the constructs of formative assessment such as questioning, motivation and student affectivity and feedback. Redfield and Rousseau (1981, as cited in Heitz, 2013) explored the relationship between the level of lecturer questioning and student achievement. They conducted a meta-analysis of twenty studies on lecturers' use of "higher" and "lower" cognitive questions. Their results showed that gains in student achievement can be expected with predominant use of higher-order questions during instruction. Some years later, Butler (1988) reported that lecturer feedback as part of the evaluation process can affect both interest and motivation (cited in Heitz, 2013).

Ramaprasad (1983) developed a theory on the role of feedback in student learning. He based his ideas on the concept of understanding where the student ought to go in relation to where the student currently is and described methods for reducing the discrepancy between the two. He suggested that feedback should not only give information about the students' current work in comparison with the reference level, but also provide students with the information needed to improve the quality of subsequent work. Heitz (2013) suggested that Ramaprasad's definition has three important applications for formative assessment: (1) the source of feedback can come from any system parameter; (2) both students and lecturers must be a reference level for comparison (e.g., students must have clear learning targets); and (3) feedback must be used to reduce any discrepancy. This means that the feedback generated from formative assessment must function to make changes in students' learning status and help them to close the gap between where the students currently are and the desired learning goals. Later, Sadler (1989) refined Ramaprasad's ideas when he proposed the feedback

function as part of a widely accepted model of formative assessment to form an instructional system where assessment is designed to help learning.

Black and Wiliam (1998a) stressed that an assessment is formative only when the information is used to inform or adapt instruction. Through their most influential publication, *Inside the Black Box: Raising Standards Through Classroom Assessment*, which included a meta-analysis of around 250 articles and book chapters on formative assessment, Black and Wiliam (1998b) asserted that formative assessment can be a powerful method leading to significant learning gains particularly for poor achievers. They confirmed that formative assessment could raise student success when lecturers incorporated the practices of formative assessment into their classroom structure. Another notable and important component of their study is the development of the theoretical framework for the use of formative assessment in the classroom. Black and Wiliam (1998b) suggested the setting of clear goals, devising appropriate learning tasks, using feedback to guide instruction and using self- and peer-assessments in the process of assessment are the essential elements of any strategy to improve learning.

However, Black and Wiliam (1998b) reported there were serious gaps in the research and development of formative assessment. First, many of the studies they reviewed had insufficient findings or produced conflicting results which made it difficult to draw conclusions. Moreover, the reviewed studies claimed to be about formative assessment, but upon review they were something totally different. Further, a lack of detail was observed in distinguishing between summative and formative assessment, and Black and Wiliam (1998b) concluded that there was insufficient clarity about the assessments' purpose.

According to Broadfoot et al. (1999), "the term *formative* itself is open to a variety of interpretations and often means no more than that assessment is carried out frequently and is planned at the same time as teaching" (p. 7). Hence, they recommended employing the term

assessment for learning (AfL) instead. This term, “assessment for learning”, appeared for the first time in a paper at the annual conference of the Association for Supervision and Curriculum Development (James, 1992, as cited in Andrade & Cizek, 2010). Andrade and Cizek (2010) also noted that the term AfL appeared as a title of two books later; however, the first use of the term assessment for learning as a counterpoint to assessment of learning (AoL) was found in a work by Gipps and Stobart (1997). The definition of AfL provided by the Assessment Reform Group (Broadfoot et al., 2002) is: “Assessment for learning is the process of seeking and interpreting evidence for use by learners and their lecturers to decide where the learners are in their learning, where they need to go and how best to get there” (pp. 2–3). However, both Bennett (2011) and Ecclestone (2010) made the point that there was a significant overlap between the meaning of AfL and formative assessment. In fact, the terms have been used interchangeably in the literature since their introduction.

Afterwards, the interest in exploring formative assessment continued to grow. From providing lecturers information about students’ learning at a point where adjustments to instruction can be made, to being indispensable from teaching and reducing the range of achievement in a class while raising the overall achievement (Black & Wiliam, 1998b). Cizek et al. (2019) further described that each component of formative assessment is important in raising students’ levels of achievement, helping to close students’ achievement gaps and building their learning-to-learn skills.

Aschbacher and Alonso (2006) examined the use of formative assessment in elementary science notebooks and found that formative assessment practices produced gains in student achievement. They also reported that formative assessments do not have to be formal. Meanwhile, Popham (2008) shed light on the pivotal role that formative assessment can play in transforming education into a more powerful and positive process. He argued that formative assessment can improve teaching and learning as well as change the climate of a

classroom from grade competition to student-teacher collaboration on meeting specific learning goals. Popham (2008) also put more emphasis on using formative assessment as a method to change the culture of school through learning communities centred on the sharing and professional development of formative assessment teaching strategies.

2.5 Definition of Formative Assessment

A plethora of definitions has been proposed for formative assessments in the literature which makes it difficult to find a definitive definition. Formative assessment has been defined differently based on a variety of perspectives. One of the potential reasons for inhibiting the greater penetration of formative assessment in the classroom could be the wide range of inconsistent definitions for formative assessment proposed in the literature (Filsecker & Kerres, 2012; Havnes et al., 2012).

Black and Wiliam (1998a) proposed one of the first formal definitions of formative assessment. They described it as “all those activities undertaken by lecturers, and/or by their students, which provide information to be used as feedback to modify the teaching and learning activities in which they are engaged.” (pp. 7-8). Later, Black and Wiliam (1998b) updated this definition by adding that an assessment becomes formative “when the evidence is actually used to adapt the teaching to meet student needs” (p. 2). Bell and Cowie (2001) further added that formative assessment is “the process used by teachers and students to recognize and respond to student learning in order to enhance that learning, during the learning” (p. 536). Black and Wiliam (2009) revised their previous definition of formative assessment to shed light on formative assessment’s role in instruction:

Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by lecturers, learners, or their peers, to make decisions about the next steps in instruction that are likely to be better, or better

founded, than the decisions they would have taken in the absence of the evidence that was elicited. (p. 9)

Heitz (2013) noted that the definition made by Black and Wiliam (2009) has brought attention to the key components of formative assessment that can help understand its key features. It is obvious from the definition that they emphasised the importance of feedback and instructional adjustment which they regarded as the main components of formative assessment. Feedback is an important component that is commonly found in the definitions of formative assessment. Sadler (1989) pointed out that “feedback is usually defined in terms of information about how successfully something has been or is being done” (p. 120). Thus, the value of feedback is when it provides information on correct responses rather than incorrect ones (Hattie & Timperley, 2007) and this information is “about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way” (Ramaprasad, 1983, p. 4). Formative assessment does not take the form of a specific instrument or task, but is defined by its purpose (Shepard, 2009).

One of the main components in the proposed definitions of formative assessment in the literature is that formative assessment is used to adjust instruction while learning is taking place. Formative assessment is defined as “assessment carried out during the instructional process for the purpose of improving teaching or learning” (Shepard et al., 2005, p. 75, as cited in Heritage, 2010). Miranda and Hermann (2015) added that modifying instructions should be done “in real-time” and teachers would be able to adapt their teaching more effectively when formative assessment is “regular and ongoing throughout a lesson” (p. 83). What is more, formative assessment enables lecturers to determine students’ understanding, and to identify any misconceptions that they may have (Hattie, 2012).

Shavelson (2006) differentiated between three types of variations in formative assessment practices: (a) on-the-fly, (b) planned-for-interaction, and (c) formal and embedded

in curriculum. On-the fly assessment spontaneously occurs during teaching, whereas planned-for-interaction is deliberate and can be decided before instruction. Curriculum-embedded assessment is embedded in the ongoing curriculum to intentionally gather data at key points during the learning process. Heritage (2007) categorised these three broad types to be a variety of strategies for gathering evidence of student learning.

Heritage et al. (2009) defined formative assessment as “a systematic process to continuously gather evidence and provide feedback about learning while instruction is under way” (p. 24). Likewise, the Council of Chief State School Officers (CCSSO) (2018) revised the definition of Formative Assessment for Students and Teachers (FAST) State Collaborative on Assessment and Student Standards (SCASS). They described formative assessment as “a planned, ongoing process used by all students and lecturers during learning and teaching to elicit and use evidence of student learning to improve student understanding of intended disciplinary learning outcomes and support students to become self-directed learners” (CCSSO, 2018, p. 2).

Indeed, formative assessment is not about assessing students to give them grades, but it is about providing feedback in order to determine the next steps that should be taken in the teaching process to facilitate the learning process. Assessment for learning (AfL) is “the process of seeking and interpreting evidence for use by learners and their teachers to decide where the learners are in their learning, where they need to go and how best to get there” (Assessment Reform Group, 2002, pp. 1– 2, as cited in Heritage, 2010). Hence, formative assessment is a process not a test. This process comprises gathering information from students, interpreting students’ responses, providing feedback to students, and adjusting instruction to improve student-student learning (Abell & Siegel, 2011; Black & Wiliam, 1998; Bell, & Cowie, 2001b; Ruiz-Primo & Furtak, 2006, 2007; Buck & Trauth-Nare, 2009, as cited in Muslu, 2017). However, researchers have agreed that formative assessment can be

either a planned or unplanned process (Kenyon, 2019). Considering the above-mentioned definitions, historical information, and the key features of formative assessment found in the literature, the following definition is developed and will be used in this thesis:

Formative assessment is an ongoing process in which various tools and strategies, planned or unplanned, used during the learning process to provide lecturers and students with feedback so teaching and learning can be adjusted to close the gap between current learning and desired goals.

This definition of formative assessment reveals several key features:

- (1) Formative assessment is an “ongoing process” unlike summative assessment.
- (2) Formative assessment includes not only a set of informal strategies, unplanned and used on the fly, but also structured strategies, planned prior to instruction.
- (3) Formative assessment is characterised by data being gathered about student learning during the learning process and action is taken during it. If formative assessment is not conducted during this process, students may not be able to monitor their progress and gauge how they will perform in the summative assessments.
- (4) Both lecturers and students are engaged in the formative assessment process to adjust the next steps in teaching and learning.
- (5) The function of feedback is to provide information to help both students and lecturers adjust and close the gap between the current level of student understanding and the intended learning goals, and then in this way improve what and how students learn.

The next section describes the process of formative assessment.

2.6 The Process of Formative Assessment

To ensure the effectiveness of formative assessment, the key components of formative assessment must be presented in classroom practices (Black et al., 2003; Cauley & McMillan, 2010; Heritage, 2007; McManus, 2008; Stiggins & Chappuis, 2005, as cited in Eddy et al.,

2017). Thus, to identify the components of formative assessment, it is imperative to clearly outline the process of formative assessment first. The process of formative assessment is “the mechanics or steps required to effectuate a judgement” (Taras, 2005, p. 467). Based on the views of Sadler (1989) and Black and Wiliam (1998), the process of formative assessment involves: “(1) specifying and conveying standards, (2) collecting assessment data on where students are in relation to these standards, and (3) sharing the data with students via detailed feedback” (Laud & Patel, 2013, pp. 2-3).

Wiliam and Thompson (2007) developed their theory of formative assessment after researching the effects of the formative process which relied on Ramprasad’s (1983) process of effective feedback or the three key processes in learning and teaching. They adapted sociocultural views and stressed the importance of student-lecturer and student-student interactions and empowering students. Wiliam and Thompson (2007) proposed the following three key processes in learning and teaching, establishing: (1) where the learners are in their learning, (2) where they are going, and (3) what needs to be done to get them there (p. 63). Different agents are involved in these three processes: the lecturer, the student, and peers. Wiliam and Thompson believed that during formative assessment, both lecturers and students as learners or peers need to take responsibility of the learning.

Wiliam and Thompson (2007) conceptualised formative assessment as consisting of five key strategies and one “big idea”. The five key strategies are:

1. Clarifying and sharing learning intentions and criteria for success.
2. Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding.
3. Providing feedback that moves learners forward.
4. Activating students as instructional resources for one another.
5. Activating students as the owners of their own learning.

The “big idea” is the use of evidence about student learning to make instructional adjustments to better meet student learning needs. As shown in Table 2.1, their framework synthesises how the five key strategies could be activated by the three agents (lecturer, peer and learner), within the three central processes (where the learner is going, where the learner is right now and how to get there) in learning and teaching.

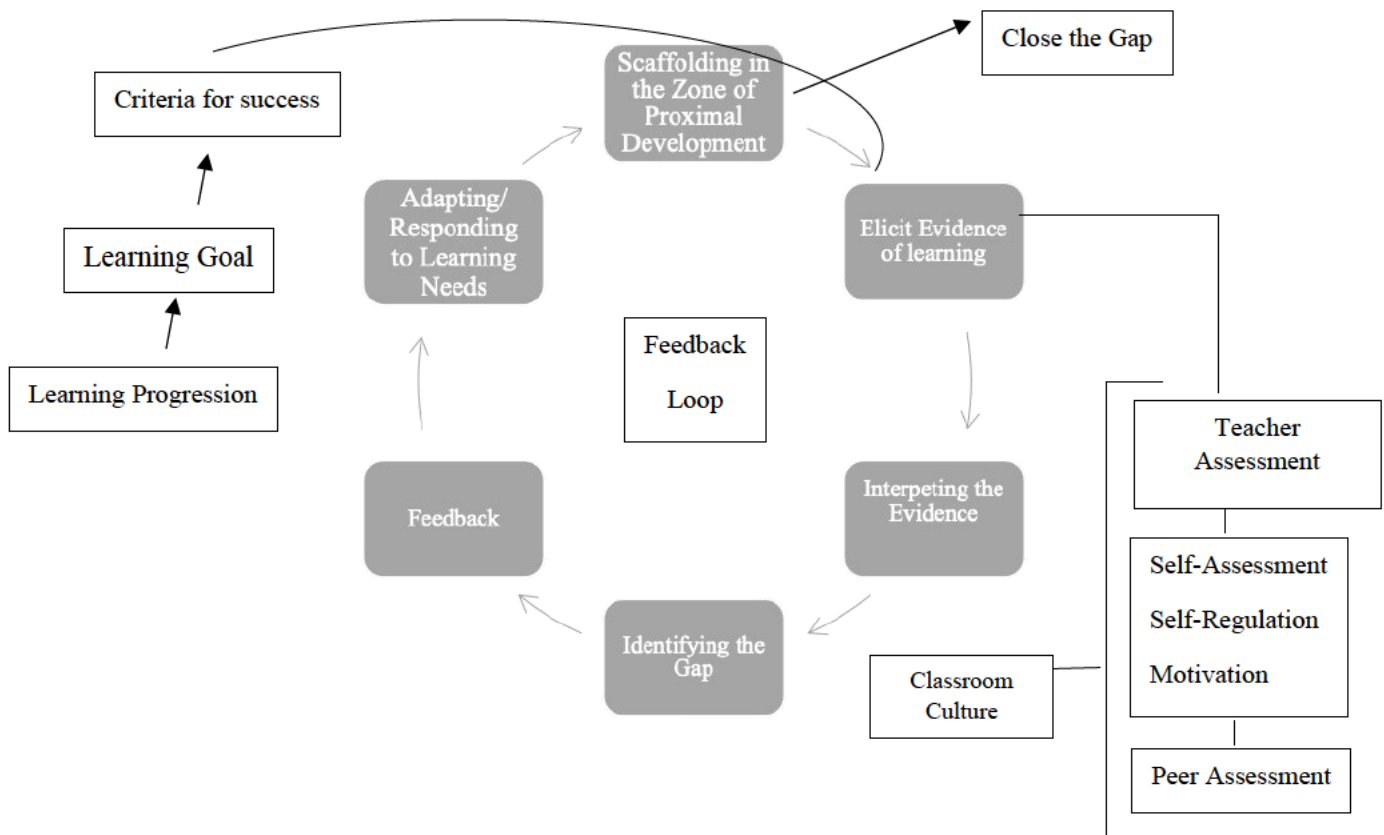
Table 2.1

Framework of Formative Assessment Strategies and Instructional Processes (Wiliam and Thompson, 2007, p. 63).

	Where the learner is going	Where the learner is right now	How to get there
Teacher	Clarifying learning intentions and criteria for success.	Engineering effective classroom discussions and other learning tasks that elicit evidence of student understanding.	Providing feedback that moves learners forward.
Peer	Understanding and sharing learning intentions and criteria for success.	Activating students as instructional resources for one another.	
Learner	Understanding learning intentions and criteria for success.	Activating students as the owners of their own learning.	

Herman et al. (2015) illustrated that formative assessment is a dynamic process that involves evidence elicitation, analysis, and action, which clearly makes demands on lecturers' content and pedagogical knowledge. The process of formative assessment involves being clear on learning goals, eliciting and analysing evidence of student status in relation to the learning goals, providing feedback and taking action to close any gap between students' status and the desired goal(s) (Black & Wiliam, 1998b, 2009; Black et al., 2003; Hattie & Timperley, 2007; Heritage, 2010; Sadler, 1989).

To better identify the components and the practices of formative assessment, Heritage (2010) proposed a cycle for the formative assessment process which is applicable to all classrooms in all subject areas (Figure 2.1). She described formative assessment as a continuous process integrated into instruction to close the gap between current learning and desired goals. When that gap is closed, another one opens as the student moves to the next stage of learning. In this way, formative assessment is used to close the gap once again and keep making advances in learning. Below is an explanation of each construct in the cycle.

Figure 2.1*The Process of Formative Assessment (Heritage, 2010, p. 11)***2.6.1 Determining Learning Goals and Defining Criteria for Success**

As can be seen at the top left of Figure 2.1, the process of formative assessment begins from the criteria of success. The first thing that lecturers must do is to identify the learning goal(s) for a lesson or a sequence of lessons and determine the criteria for success. These goals and success criteria are shared with the students before the lesson(s) begin. The purpose of identifying learning goals is to know what the students will learn during the lesson. As can be seen from Figure 2.1, the learning goal is derived from a learning progression.

Learning progressions are the trajectories of learning that show the growth of student learning. According to Heritage (2010) learning progressions describe pathways of learning, and therefore, provide the clarity that lecturers need. Learning progressions can assist

lecturers in planning their instruction. When lecturers understand the continuum of learning in a domain and have information that allows them to compare students' actual levels of learning with learning goals, they are better able to make decisions about the next steps in learning.

The success criteria are used as checks on learning to identify what it takes to meet the learning goal. Success criteria function as a guide of learning while the student is engaged in learning tasks. Wiliam and Thompson (2007) also considered that clarifying and sharing learning intentions and criteria for success as one of the important key strategies that conceptualised formative assessment as shown in Table 2.1. To sum up, learning goals and criteria for success must be clearly articulated by lecturers and clearly understood by students because both learning goals and success criteria drive the whole process of formative assessment.

2.6.2 Eliciting Evidence of Learning

After determining learning goals and defining criteria for success, the lecturer then plans formative assessment strategies to elicit the evidence needed to provide feedback for learning. Heritage (2010) illustrated that there are a variety of approaches that can be used to elicit evidence of how student learning is progressing toward a goal. For example, lecturers can use “planned questions, observation, instructional tasks (representations, explanation, performance, problem-solving), exit cards, notes to the lecturer, or curriculum-embedded assessments” (pp. 11-12). Consequently, student responses to the questions or tasks during the session provide evidence of their understanding of the current topic being discussed. For example, students show their comprehension level through their responses to a quiz or an exit ticket (Marzano, 2017).

Whether these strategies are planned or occur spontaneously during the lesson, the most important thing about the strategy employed is that it should be aligned to the learning

goals and success criteria. Furthermore, the employed strategy should be of sufficient quality to enable lecturers to access information about how learning is progressing so they can take appropriate action. Lecturers can take an action and make the necessary instructional adjustment during the lesson or address the identified misconception or a difficulty in learning in subsequent lessons. Moreover, keeping in mind that assessment is not ‘a one size fits all’ scenario, the formative assessment strategies must consider the different skills and levels of understanding to permit all students to know where they are in their education. Heritage (2010) recommended using more than one strategy, so that the lecturer can have several ways to elicit evidence of student learning and students will have an opportunity to demonstrate their understanding through a variety of sources. For instance, lecturers can pose “a range of questions that invite explanations, a representation to illustrate level of understanding, and a discussion among peers” (Heritage, 2010, p. 59).

The collected data should also reveal strengths and weaknesses not only in individuals but also in curriculum and instruction. Lecturers should make sure that these data are valid and appropriate for purpose. The data should be able to provide information to keep learning a sustained effort. Assessment reliability is also important and it refers to the consistency of the assessment results. Shepard (2000) noted that to help students take the next steps, lecturers should be able “to ask the right questions at the right time, anticipate conceptual pitfalls, and have at the ready a repertoire of tasks” (p. 12). In short, before commencing a lesson, lecturers should know what they want their students to learn, what tasks are to be used to facilitate learning and how would they gather evidence about their students’ progress.

The next step in the process requires the interpretation of evidence.

2.6.3 Interpreting the Evidence

After gathering the evidence from formative assessment, the next step is to examine the evidence with reference to student learning. The learning goals and criteria for success

provide the framework for the evidence interpretation to identify gaps in learning. This helps determine the status of student learning: “what the students understand, what their misconceptions are, what knowledge they have or do not have, and what skills they are or are not acquiring” (Heritage, 2010, p. 12).

Sadler (1989) noted that the learning gap will vary from one student to the next. Heritage (2010) further explained that sometimes lecturers do not have to make any instructional adjustments because students have already met the success criteria. On the other hand, they may need to elicit further evidence when there is not enough evidence to ascertain the students’ current learning status. Thus, lecturers can use different sources of assessment data to better understand their students’ learning, determine levels of achievement, know what learning has been accomplished and make pedagogical adjustments accordingly. Heritage (2010) also clarified that while students are engaged in learning, they are using the success criteria to keep track of how well they are progressing toward the goal, and to adjust their learning when necessary. For instance, when students are involved in peer assessment, they also use the success criteria to interpret the evidence and provide feedback to each other about how learning can be improved. To handle this step effectively, students must understand what the success criteria actually mean. The next step requires the lecturers to identify the gap.

2.6.4 Identifying the Gap

Lecturers must interpret the evidence from formative assessment tasks to identify the gap. As noted earlier, the purpose of formative assessment is to close the gap between the students’ current learning status and the intended learning goal. Students do need to be in a situation where something is unknown, otherwise learning is not advancing and they do not absorb new information.

Heritage (2010) made a clear distinction between “identifying the gap” and the “achievement gap”. She illustrated that the latter is the “gap in achievement between some subgroups of students and others” (Heritage, 2010, p. 12). Heritage (2010) added that formative assessment is a process to identify the “just right gap”. The “just right gap” has been interchangeably referred to as the Zone of Proximal Development (ZPD) (Vygotsky, 1978), which is explained in the research framework section in this thesis. Hence, when lecturers interpret evidence to identify the gap, it means they identify the next steps in learning that students can take within the ZPD. Hence, closing the gap is achieved by responding to the evidence through feedback, which results in adaptations to instruction and to learning. The next step involves feedback.

2.6.5 Feedback

Feedback can serve as an opportunity for additional teaching to support student gaps or misconceptions in their understanding of the content (Williams, 2020). For formative assessment to thrive, it is vital to consider the importance of feedback. It is one of “the most powerful influences on learning and achievement” (Hattie & Timperley, 2007, p. 81). Sadler (1989) identified three conditions for effective feedback. For a student to be a good learner, he/she must: “(a) possess a concept of the standard (or goal, or reference level) being aimed for, (b) compare the actual (or current) level of performance with the standard, and (c) engage in appropriate action which leads to some closure of the gap” (Sadler, 1989, p. 121). Sadler also stressed that for the students to improve their performance, they should know that they are progressing. They need to develop skills in evaluating the quality of their work, especially during the process of production. Stated explicitly, there should be a transition from lecturer-supplied feedback to learner self-monitoring. Lecturers should provide their students with direct and authentic evaluative experience to provide them with the necessary evaluative expertise.

The third key strategy identified by Wiliam and Thompson (2007) in their framework (Table 2.1) is providing feedback with which students improve.

Lecturers are not the only ones who can provide feedback. Peers can also provide feedback about each other to help their classmates improve learning and students themselves can get feedback through self-assessment. Wiliam and Thompson (2007) indicated that the lecturer, the learners, and their peers are the different agents who are involved in the assessment process as shown in Table 2.1. Feedback can be generated by lecturers, peers and the students themselves.

Boud and Molloy (2013) suggested that feedback should be considered as a fundamental element of curriculum design. It can be shown through day-to-day practices that aim to develop student self-regulation. Despite the indisputable importance of feedback, Price et al. (2011) noted that there is a potential for feedback to be misinterpreted or inappropriately delivered or received. Hence, lecturers must know how to provide effective feedback and their students should be provided with guidance on how to understand and use it. For instance, providing a lot of feedback does not always lead to substantial benefits. Price et al. (2011) made the point that a content-focused approach to feedback provides further knowledge in feedback, whereas a more facilitator-focused approach will be more centred on the learning process and eventually lead to students developing their metacognitive skills. To illustrate, formative assessment provides lecturers with feedback that they feed forward into their instruction to improve student learning. This is formative feedback for teaching. Conversely, student feedback comes from their own internal monitoring during learning which is through self-assessment or externally from their lecturers or peers and this is feedback for learning. Delivering feedback to students goes beyond stating right and wrong answers. It provides students with additional suggestions of how they can increase their understanding of the subject. If students show strengths in the subject, the lecturer can

provide feedback on how to apply their understanding to a new type of knowledge or a more complex version of the task that was just completed (Williams, 2020).

Highlighting its importance further, Hattie and Timperley (2007) stated that for feedback to be effective, regardless of its source, it must answer three major questions asked by a lecturer and/or by a student. The first question, “Where am I going?” indicates that the student should know the objective or the goal of the task, or what they should be able to do or learn from the task. The second question, “How am I going?” signifies that the student should be advised of how they are performing and progressing according to the specified goal. Third, “Where to next?” means the activities that need to be undertaken to make better progress (Hattie & Timperley, 2007, p. 86). Hence, formative feedback is an articulation of students’ needs and strengths that are based on the evidence of their learning (Chappuis & Stiggins, 2017). The lecturer communicates these needs and strengths through feedback to their students providing them a tangible information to improve their academic learning (Mulliner & Tucker, 2017).

It is worth mentioning that when quality feedback is provided, improvements in learning occur (Black & Wiliam, 1998b). The quality of the feedback requires knowledge of the students’ metacognitive abilities (Vygotsky, 1962; Wheatley et al., 2015, as cited in Williams, 2020) and it also demands an engagement in the process by both the lecturer and the student (Darling-Hammond et al., 2003, as cited in Williams, 2020). Furthermore, researchers stated that it is better to provide students with timely feedback, especially if they are learning new concepts or skills. Timeliness of feedback allows students to adjust their learning comprehension and allows lecturers to reteach or adjust their instruction, as a part of the cyclic process of formative assessment (Bayerlein, 2014; Fulcher et al., 2014; Purcell, 2014; Wanner & Palmer, 2018; Zimbardi et al., 2016, as cited in Williams, 2020).

According to Gikandi et al. (2011), feedback is effective when it is highly related to clearly identified learning goals so that effective formative feedback is not only based on monitoring students' progress toward the specific learning goals but also what promotes students to develop effective learning strategies. These processes characterise formative assessment and are aimed at supporting learning. Therefore, lecturers need to provide their students with suggestions and hints for how to improve their learning rather than just correct answers. More importantly, lecturers need to provide feedback that helps students build their range of learning skills, strategies, and tactics, which they can employ in various learning domains. They can assist their students to develop the skills of peer and self-assessment. The next step is considering the learning needs of the students.

2.6.6 Adapting and Responding to Learning Needs

Formative assessment is designed to “efficiently measure how well students are responding to instruction in a specific subdomain of achievement” (Neumann et al., 2019). Wiliam (2010) clarified that the feedback received from formative assessment to both lecturers and students can maximise student learning through individualised teaching strategies. Based on the feedback received from formative assessment, lecturers plan the actions that they would take to align their instructions with the students' learning needs. They need to adapt their teaching to meet the diversity of students' needs. The adjustment depends on the gaps identified in student learning. In some circumstances, lecturers may need to reteach some concepts to attain an improved level of student understanding (Williams, 2020). The selected learning experiences would be expected to close the gap between where the students are in their learning right now and where they need to go.

Moreover, students also adjust their own learning by being engaged in self-assessment. They select the most appropriate strategies from their repertoire so that they can

make progress (Heritage, 2010). The next section considers the step of scaffolding teaching to support learning.

2.6.7 Scaffolding New Learning

According to Heritage (2010), Wood et al. (1976) defined the term “scaffolding” as the support that students received from lecturers or peers to move from what they already know to what they can do next and close the gap. Thus, scaffolding occurs when support is provided through a process of interaction. For instance, a lecturer may ask leading questions or probe to ascertain the knowledge that students already possess with the intention of providing feedback to support students to advance through the ZPD. Students respond in the process of scaffolding by receiving the feedback and using their own learning strategies, in collaboration with the lecturer’s instructions, to improve their learning. The scaffolding is then gradually reduced as each student’s competence grows until the student can work independently.

Formative assessment takes place during scaffolding to determine the degree to which the learner is progressing and may result in further instructional or learning adjustments if the gap is still not closing (Heritage, 2010). Formative assessment assists lecturers to collect information to tune and scaffold successfully (Beatty & Gerace, 2009). This leads to the next step, which is to close the gap.

2.6.8 Closing the Gap

Policymakers and educators are concerned with strategies to close the gap (Bloom, 1974; Guskey, 2005; National Academy of Science, 2007; Stiggins & Chappuis, 2005, as cited in Heitz, 2013). The final step in the process of formative assessment identified by Heritage (2010) is about the gap closure. According to Sadler (1989), feedback consists of two components: (1) gathering information about the gap; and, (2) doing something to minimise the gap. The idea of closing the “gap” originated with Sadler (1989), who stressed

feedback as the focus of formative assessment. Following Ramaprasad (1983), he emphasised that information is only considered feedback when it is “used to alter the gap” (Sadler, 1989, p. 121). Feedback can be used to close the gap between where students currently are and where they need to go to achieve the learning goal. When the gap is closed, another gap opens as a student’s learning progresses to the next stage or level, and formative assessment is used again to close that gap. Subsequently, the lecturer moves to new learning goals and then another gap is identified. Sadler (1989) explained that if the gap is too large, the learning goal in this case is regarded as unattainable. In contrast, if the gap is too small, closing it may not require any additional effort.

Stated clearly, identifying the “just right gap” is what is needed when implementing formative assessment. Heritage (2010) described the “just right gap” as the zone of proximal development (ZPD). It refers to using formative assessment to facilitate students’ cognitive growth through collaboration and guidance. The whole process of formative assessment depends on a classroom culture where students feel comfortable asking questions, giving, and receiving feedback from their peers. The next section discusses the classroom culture.

2.6.9 Classroom Culture

A positive or healthy classroom culture is considered indispensable to implementing the process of formative assessment effectively. Lecturers must establish a classroom culture where there is recognition and appreciation of individual differences (Heritage, 2010). Since feedback is the backbone of formative assessment, it must be effective. According to Heritage (2010), for feedback to be effective, regardless of its source, students must value it as a method to improve their learning and this is more likely to happen in a conducive classroom culture. That is, the lecturer must establish a culture that encourages the provision and receiving of feedback. First, the power in the classroom should be distributed so that lecturers and students share the responsibility for learning. Second, the classroom should be a

“safe” place. Students should participate without fear of making mistakes or seeking help. Finally, the relationships in the classroom must be supportive and collaborative (Heritage, 2010).

It is not an easy task to follow and implement formative assessment in a classroom; however, with the integration of technology, which will be the subject of detailed discussion later in this thesis, its implementation has the potential to be much easier. The next section focuses on the integration of technology into the process of formative assessment.

2.7 Integration of Technology

Using technology has become easier in today’s digital world. It can be said the world of education has been changed significantly through ease of access to the Internet. The integration of technology in education goes along with the growth in the use of mobile devices like smart phones, iPads and Tablets, and the other wearable technologies. It is the world of digital communication technologies. It is not surprising, therefore, that the technology has impacted teaching and learning.

There is a myriad of benefits for integrating technology into teaching and learning for both lecturers and students. Recent studies have found that the use of technology in the classroom can improve students’ engagement and may improve their learning outcomes (Grier et al., 2021). Another important benefit to note is that integrating new technologies can support the learning of 21st century skills, notably problem-solving and critical thinking skills (Spector et al., 2016). It is not reasonable therefore to discourage the digital generation from using technology (Elmas & Geban, 2012, as cited in Gokbulut, 2020). Hurton (2019) stated that various benefits of technology such as making sense of concepts and procedures can be extended to technology-based formative assessment.

Formative assessment is often challenging when lecturers need to check students’ understanding during the lesson especially in large groups. It is not an easy task to develop

and implement quality formative assessment. As noted previously, lecturers must use advanced questioning strategies, provide students with direct feedback, inform learning based on their feedback, facilitate peer assessment, and assist students who need additional help (Black & Wiliam, 2009; Harris, 2007). Without the support of technology, this entire process of formative assessment is difficult to manage even with the most skilled lecturers (Stowell et al., 2010, cited in Chevalier, 2011). Integrating technology into formative assessment practices can support planning and implementing formative assessment strategies as well as adjusting classroom instruction. Luan et al. (2010) stated that the incorporation of technology into the teaching and learning process can play an essential role in changing the pedagogical role of lecturers.

Despite the above-mentioned benefits, it has been reported that technology may cause students to be overwhelmed and disengaged from learning if the use of technology is not underpinned by effective and informed pedagogy. They may also be frustrated due to technical issues such as unstable internet connections or program failures (Bedenlier et al., 2020). Hence, Bedenlier et al. (2020) asserted that it is important to make content, pedagogy, and the use of technology valuable to students and conducive to learning goals. They have also recommended that students should be familiar with the reasons for using technology and equipped with the knowledge on how to use the tools involved, and be encouraged to be engage with their peers as well.

Furthermore, technology can support lecturers' ability to incorporate effective formative assessment strategies into their classroom practice. Spector et al. (2016) noted that the ability of new technologies to provide support for formative assessment has increased considerably with the advent of intelligent agents (Ehimwenma et al., 2014; Greer & Mark, 2015; Harley et al., 2015), smart devices (Shorfuzzaman et al., 2015; Spector, 2014a; Spector, 2016) and cloud-based resources (Armstrong & Llorin, 2015, as cited in Spector et

al., 2016). Bahati (2019) illustrated that technology has great potential to make effective formative assessments through promoting “(a) immediacy of feedback, (b) meaningful and deep learning, and (c) inclusiveness” (p. 13). Thus, technology can be used to support formative feedback because of its ability to generate and make use of new sets of data.

As discussed earlier in this thesis, feedback is the main pillar of formative assessment. Formative feedback helps students identify their weaknesses, consolidate their strengths, take an active role in their learning, and motivate as well as engage them in assessment processes (Eccelstone, 2010). It is very important, therefore, for both lecturers and students to receive timely feedback because students are less likely to learn from delayed feedback (Shirran, 2006). Immediate feedback enhances student engagement, improves achievement, motivation, and self-regulation (Crisp & Ward, 2008; Zimmerman & Labuhn, 2012, as cited in Bahati, 2019). Hence, it is difficult to imagine providing timely and meaningful feedback without making use of advanced technologies particularly student response systems (SRS).

The next section explores the types of technologies that can be used to support the formative assessment process, with a focus on student response systems (SRS).

2.8 Types of Formative Assessment Technologies

With the endless stream and array of technology tools and their potential benefits to support the practice of formative assessment, lecturers are obliged on to seize new opportunities to utilise and employ the recent technologies as a superior tool for formative assessment. Such tools can add to the diversity of types of classroom assessments, including multiple-choice questions or short answers with real-time feedback of results. Currently, Artificial Intelligence (AI) is seen as a key force behind what is known as the ‘fourth industrial revolution’, and it has the potential to trigger a fourth revolution in education (Zhai et al., 2021). Although the use of AI in formative assessment is still in its early stages (Zhai & Nehm, 2023), Vittorini et al. (2021) tested an AI-based system for formative and

summative assessment in data science courses. They found that that the system provided automated feedback, reduced correction time, and detected correction errors. Yildirim-Erbasli and Bulut (2023) used conversation-based assessment (CBA) which is a new approach to formative assessment that uses conversational agents (chatbots) to measure student learning in an interactive way. CBA allows students to receive feedback and support to help them understand the material better.

AI has proven its usefulness in providing personalised feedback and evaluate performance using both qualitative and quantitative data (González-Calatayud et al., 2021). Through using adaptive algorithms, AI can be integrated with certain applications and web-based tools to help in generating questions, creating assignments, providing instant feedback and recommendations. Afzaal et al. (2021) proposed a novel approach in which they utilised AI to develop a dashboard that provides data-driven feedback and action recommendations to support student learning. AI can monitor learners' progress, identify their needs, and adjust their instruction accordingly through providing automated grading and feedback (González-Calatayud et al., 2021; Shin et al., 2022). Moreover, Web 2.0 platforms (web-based media such as social media networks, blogs, e-portfolio, wiki), student response systems (SRS) and game-based digital forms have been shown to effectively contribute to formative assessment practice and feedback provision (Van der Kleij & Adie, 2018).

Generally, without technology, the assessments would be conducted through conventional methods comprising traditional paper-based assessments. Alzaid and Alkarzae (2019) found that it is hard to offer various individuals repeated demonstrations of assessment during a short period of time and it is also difficult to provide timely customised feedback to all students through traditional paper-based formative assessment. On the other hand, technology-based formative assessment can provide “flexible multiple attempts,

immediate feedback with less time and minimal human efforts” (Alzaid & Alkarzae, 2019, p. 27).

Given that there are numerous benefits to the integration of technology-based formative assessment, it is imperative to consider the quality of the technology tools for responsive pedagogical integration. Grier et al. (2021) suggested using a variety of technology assessments to meet students’ needs. Students have their own preferences and personalities. For instance, some students may prefer the competitive nature of *Kahoot* while others may prefer the self-paced non-competitive nature of *Google Forms*.

The following section discusses the use of the student response system (SRS).

2.8.1 Student Response System (SRS)

There are countless tools of education technology (EdTech) that provide analytical data and can be used for formative assessment. One such technology is called the student response system (SRS). SRS is colloquially known as “clickers”. It is also known by several names in the literature, including but not limited to, classroom response system (CRS), audience response systems (ARS), personal response systems (PRS), classroom communication systems (CCS), electronic response systems (ERS), electronic voting systems (EVS), polling systems, or clicker systems (Aljaloud et al., 2015). Clickers came into existence in the 1950s but their popularity as a tool of formative assessment has been limited to the last 10 years and mostly focused on large, post-secondary school lecture hall contexts (MacGeorge et al., 2008; Medina et al., 2008, cited in Chevalier, 2011). However, clickers have been replaced more recently by smartphone applications (apps) and virtual learning environment utilities.

SRS includes all the technology-based formative assessment tools that are used for instantly gathering student-level data in the classroom. In its simplest form, SRS is a polling system through which lecturers can pose a wide range of questions through the combination

of hardware (handheld clickers, receiver, PC, internet connection, projector and screen) and software. In turn, students can respond quickly and anonymously, and the lecturer can display the response data immediately and graphically (Price et al., 2011). Some studies (Beatty, 2004; Burnstein & Lederman, 2003; English, 2003) defined SRS as technology that “allows an instructor to present a question or problem to the class; allows students to enter their answers into some kind of device; and instantly aggregates and summarizes students’ answers for the instructor” (cited in Mahon, 2012, p. 2).

Caldwell (2007) and Kenwright (2009) explained the procedures of using SRS in a classroom as follows. First, the lecturer poses questions that are also displayed on an interactive white board. Then, each student enters the answer to each question using their smart phone or tablet. Finally, the response system instantaneously gathers and organises every student’s response in many instances in the form of a chart. By displaying information of students’ responses in this form, the lecturers can easily investigate the students’ learning situations by interpreting charted response information. Fuller and Dawson (2017) further elaborated that based on the interpreted results, lecturers may inform instructional pacing or material to instantaneously meet students’ needs. A visual presentation of their responses can be shown in the interactive board anonymously. From the graph, the lecturer and students can notice if there are many students who do not understand the concept. This step eliminates any embarrassment for the student by letting everyone know that they have made a wrong answer. Additionally, lecturers can measure the level of student understanding and increase the level of difficulty of the questions based on the number of right answers. Consequently, students can work together on their mistakes and lecturers can have discussions with their students that elicit high levels of critical thinking (Caldwell, 2007).

A considerable number of researchers have addressed the utility of SRS as a powerful tool for formative assessment (Brewer, 2004; Caldwell, 2007; Kenwright, 2009; Trees &

Jackson, 2007, as cited in Chevalier, 2011). SRS, which can be implemented in very large classrooms or small groups, is regularly used in collecting students' responses while implementing diagnostic, formative, or summative activities during class time. The most significant integration of SRS is via assessment, especially of the formative kind. SRS tools can facilitate formative assessment considerably because they provide instantaneous feedback. This feedback can be included for each question, or the lecturer can decide on how to provide it depending on real-time results (Cerqueiro & Harrison, 2019).

The benefits of SRS tools are manifest. SRS tools are flexible and can be used for individual or group assessment before, during or after the class. SRS tools are free, in most cases, and can be accessible from any smart device with the availability of an internet connection. These tools allow an automatic collection of data, save students' responses in the software, so the lecturer can return to these responses at any time to evaluate each student's performance, diagnose any areas of difficulty for individual students, and plan to address these difficulties. SRS tools can be used with small groups working collaboratively or with large groups all at once. Additionally, SRS provides a new communication channel between the learner and the instructor which can be integrated into curriculum design (Siau, Sheng, & Nah, 2006, as cited in Şahin, 2019).

SRS is regarded as a cost-effective solution for students and for the institution because a wide range of SRS tools are freely available and they provide greater flexibility in use from a BYOD (Bring Your Own Device) perspective. The evidence from the literature is that SRS provides lecturers with a tool whose use, in the context of formative assessment, can contribute to students' learning and promote higher levels of cognition. SRS tools have been refined due to the improvement of web technologies; not only increasing the diversity of tools but also the type of questions, including multiple-choice, short answer and open-ended questions, drag-and-drop, puzzle, and gamification elements. In addition to these, the recent

tools provide detailed information to the lecturers on each student's performance, the performance of the group, the percentage of correct responses for each question, and the response time associated with each question. It is also worth noting that this information has the potential to affect the learning environment and based on it, environments or applications can be reconstructed or reorganised (Şahin, 2019).

Although there are certain distinctive features among SRS tools, their capacity to collect and compile students' responses in real-time is one common similarity among them. More importantly, regardless of whether it is a hand-held clicker or web-based software, SRS tools can provide real-time formative assessment data that support lecturers' instructions, as well as promoting learning. Several technology-based (SRS tools) can currently be incorporated into formative assessment practice, some of which are summarised by Kenyon (2019, pp. 307-309) in Table 2.2. This is not a comprehensive list of SRS tools, but a selection of some of the most widely used ones.

Table 2.2

SRS Tools

Name and Web Address	Description
AnswerGarden https://answergarden.ch/	Online polling. This real-time tool allows teachers to see student feedback when asking questions to check for student understanding.
AnswerPad http://www.theanswerpad.com/	A blank page that functions like an individual whiteboard for each student.
Clickers (personal response devices)	Teachers use a software program where they can ask questions to check for student understanding. Students use a device to input their answers anonymously. The teacher can see (or post for students to see as well) real-time feedback to immediately address misunderstandings.
Formative https://goformative.com/	This site provides teachers with the opportunity to check for student understanding by asking questions, receiving the results in real time, and then providing immediate feedback to students.
Google Forms	A Google Drive application that allows teachers to create

https://www.google.com/forms/about/	documents that students use to take formative assessment quizzes. Real-time data response software allows teachers to quickly analyze data by question.
Kahoot https://kahoot.com/	A game-based classroom response system. This fast-paced, fun quizzing game can be used during formative assessment to see student answers in real-time, to give immediate feedback to students, and to reteach content.
Mentimeter https://www.mentimeter.com/	Fill presentations with questions to ask students to check for understanding. Real-time results help teachers adjust instruction.
Padlet https://padlet.com/	Students can share responses by posting onto an online “board.” Great for exit tickets.
Pear Deck https://www.peardeck.com/	Quick to make and share. Add-on to Google Slides. Allows you to make interactive presentations where students can follow along on their own device and participate in formative assessment activities.
Plickers https://www.plickers.com/	Check for understanding in classrooms with limited technology—only need one teacher device. Print answer cards from the website. Students are given a card. Each code card can be turned in four orientations for the answers A, B, C, D. Use the Plickers mobile app to scan the answers students hold up on their cards and see a bar graph of responses.
Poll Everywhere https://www.polleverywhere.com/	Once students record their response on a device, the results can be displayed on a screen in real-time. Use this tool as a way to collect immediate formative data in any content area.
Quia https://www.quia.com/web	Create games, quizzes, surveys, and more to check for student understanding. Can access a database of existing quizzes from other educators to save time.
Quizalize https://www.quizalize.com/	Fun classroom team games. Instantly know who needs help and what they need help with. Effortlessly assign follow-up activities that boost student results.
Quizizz https://quizizz.com/	Use in class as teams or as self-paced quizzes to assess and engage students. Can also assign a quiz to be completed as homework. Use reports by class and student to help reflect on teaching and provide a gauge as to what students have learned.
Quizlet Live https://quizlet.com/features/live	Create flashcards, tests, quizzes, and study games that are engaging and accessible online and via a mobile device. Students work in teams and log on with a code to begin playing and compete to show their understanding of

Socrative https://www.socrative.com/	vocabulary. Educational exercises and games with real-time results that will help determine whether reteaching is needed or if the students are ready to move on to new concepts. Review reports to prepare for future classes.
Triventy http://www.triventy.com/	Free game platform for students to take quizzes. These live quizzes provide real-time data on student understanding of classroom concepts.
ZipGrade https://www.zipgrade.com/	Turn your phone or tablet into a grading machine similar to a scantron. Download answer sheets for students to fill out their formative assessment. Instant feedback by grading exit tickets and quizzes as soon as they finish. Similar to https://get.quickkeyapp.com

The next section discusses in detail the effectiveness of SRS as a tool for formative assessment purposes.

2.8.1.1 The Effectiveness of SRS as a Tool for Formative Assessment.

To implement SRS as a tool for formative assessment successfully, it is first necessary to understand the components or the key elements of formative assessment. As noted previously, there is significant evidence to suggest that SRS can contribute to effective formative assessment (Beatty, 2004; Bergtrom, 2006; Brewer, 2004; Bullock et al., 2002; Caldwell, 2007; Draper & Brown, 2004; Dufresne & Gerace, 2004; Elliott, 2003; Greer & Heaney, 2004; Hatch, Jensen, & Moore, 2005; Jackson et al., 2005; Siau et al., 2006; Simpson & Oliver, 2007; Stuart et al., 2004, as cited in Kay and LeSage, 2009). Furthermore, there are countless assessment tools available, but what makes SRS unique is its ability to collect and display data instantly. Studies have shown that feedback can improve students' level of engagement and comprehension (Addison et al., 2009; Beuckman et al., 2007; Blood & Nell, 2008; Fies & Marshall, 2006; Herreid, 2006; Stowell & Nelson, 2007, as cited in Chevalier, 2011). According to Chevalier (2011), Natriello (1987) found that students who were given instant feedback performed better compared to those who received no or delayed feedback. On top of that, the speed in which the feedback is collected allows students to make

critical interventions into their learning needs and promotes higher levels of critical thinking (DeBourgh, 2008, as cited in Chevalier, 2011). Petrucco (2019) also highlighted an important benefit of SRS which is the anonymity feature. It means that the lecturer can decide either to identify or not the student who makes each response, but the rest of the class cannot. Stated more bluntly, students feel that they are not alone in making mistakes and this reduces their anxiety.

It is important to mention that SRS effectiveness can be affected by the lecturers' preparation, construction and administration of the questions, and use of feedback information. The efficacy of SRS is also significantly influenced by lecturers' instructional strategies. It is crucial therefore, that lecturers should be adequately prepared to use SRS in their classrooms. To enable lecturers to integrate SRS formatively, it is important to first differentiate between technology and pedagogy. Beatty and Gerace (2009) noted that an enormous amount of literature considers the use of the Class Response System (CRS), as if it were a pedagogy and neglects the point that, like any tool, a CRS can be used in many possible configurations to achieve many possible ends.

Again, referring to Beatty and Gerace (2009), it is crucial to focus on the pedagogical approaches that SRS offers rather than just the learning gain from SRS. As the *Technological Pedagogical Content Knowledge* (TPACK) framework suggests, technology is more effective when supported by appropriate pedagogical approaches to meet learners' needs (Mishra & Koehler, 2006). Hence, SRS can be an appropriate tool for stimulating alternative teaching strategies, such as peer instruction.

Practising formative assessment is not simple in these learning contexts. For example, it calls for lecturers to understand students' questions and respond to them promptly to clarify misconceptions "on the fly". Black and Wiliam (1998a) recommended that formative assessment work needs significant changes in pedagogy and classroom practices to be

effectively implemented in classrooms. In addition, they stressed that feedback between lecturers and students should be enhanced. More importantly, they pointed out for assessment to be formative, results and gathered information must be used to adjust teaching and learning.

Mork (2014) examined lecturers and students in Japan and found out that there are several benefits to using SRS, like greater participation, enjoyment, motivation, group interaction, peer assessment and better learning. However, Beatty (2004) pointed out that the use of SRS for the sake of engaging students to keep them awake or to quiz them for comprehension is basically a waste of the system's potential. Therefore, SRS is primarily effective when the pedagogy is couched in the context of teaching (Beatty & Gerace, 2009; Rochelle, Penuel, & Abrahamson, 2004, as cited in Price et al., 2011). Its value comes from analysing formative assessment data and then devising real-time pedagogical solutions to maximise student learning. SRS provides the real-time information about student learning to both lecturers and students. Students can use this feedback to monitor their own learning, and lecturers can use it to adjust their instruction and change how they manage the class “on the fly” to meet the demands of their students’ learning needs.

Şahin (2019) stressed that students should take an active part in the learning process and this can be achieved by structuring learning environments to encourage students and increase their engagement. For instance, when using these systems, the essential hardware and physical infrastructure, like the electronic devices, classroom display screens and internet connections, should be provided.

SRS also enables students to be active in the learning process by providing them with an environment to discuss their questions and answers (Blasco-Arcas et al., 2013, as cited in Petrucco, 2019). This type of interaction between peers and lecturers has the potential to impact both collaborative learning and engagement and eventually improve student learning

performance. Kent (2019) used Plickers which is a quick response (QR) paper-based tool, to provide Korean English Foreign Language (EFL) learners with a digitally interactive learning environment and active learning opportunities that enhances their engagement in content and supports their development in reading comprehension skills. In a similar vein, Polly et al. (2015) found that using SRS in an elementary mathematics classroom helped the teachers to inform the direction of instruction and track students' progress. In another study, Yoon (2017) confirmed that the use of SRS leads to increased opinion-sharing, participation, and lecturer interaction in the South Korean classroom. Cerqueiro and Harrison (2019) showed that first-year university students consider using *Socrative* as an effective method for providing formative feedback.

Price et al. (2011) summarised the benefits of integrating SRS into instruction as follows: The integration can: (1) improve engagement, (2) provoke critical thinking, (3) give students voice in classroom decisions, (4) improve classroom discussion, (5) increase attendance and retention, and finally, (6) increase enjoyment within the class. Despite these benefits, some studies identified some disadvantages of using such tools. A study on using the *Socrative* SRS tool in EFL classrooms in South Korea, conducted by Yoon (2017), revealed that students were compelled to use cellular data because of a lack of good wi-fi connectivity and considered SRS an impediment in their classrooms.

The next section looks at some of the strategies that can be used with SRS tools in classrooms.

2.8.1.2 Questioning and Feedback Strategies With SRS. Questioning is considered an assessment strategy that is critical to using SRS as a formative assessment tool. A lecturer can ask questions for the purpose of gauging students' understanding, fostering discussion, eliciting feedback, or enabling student voice in what they are studying. These types of questions should be aligned with student learning outcomes (Mahon, 2012) and the objectives

of the day's lesson (Caldwell, 2007). Any irrelevant or arbitrary questions should not be used in the classroom irrespective of the use of SRS. Fuller and Dawson (2017) asserted that pacing the questions appropriately between the segments of content allows lecturers to collect formative assessment data that demonstrate students' understanding of each segment of what is being taught. It is important to pace the questions within the lesson while the lesson content flows naturally. Pacing the questions instead of posing them all at once, keeps the students attentive and engaged throughout the lesson. It should also be noted that leaving all the questions toward the end of the lesson does not allow for changing the instruction along the way (Mahon, 2012).

It is advisable also to make sure that the questions are used to target some higher order thinking skills if they are appropriate to the outcomes being assessed (Bloom's Taxonomy (Pear et al., 2001, as cited in Mahon, 2012). The discussion above supports the conclusion that the effectiveness of the SRS tool is closely linked to the type, quality, quantity, speed and sequence of the questions being asked (Bruff, 2007; Beatty & Gerace, 2009; Caldwell, 2007, as cited in Price et al., 2011).

2.8.1.3 Pedagogical Practices to Be Used With SRS. Effective usage of the output from formative assessment greatly relies on the instructional situation and the student(s) (Black & Wiliam, 2009, p. 12). Mahon (2012) confirmed that when using SRS with a carefully designed pedagogy, immediate observable outcomes in student performance can be seen. In this regard, Fuller and Dawson (2017) suggested three instructional strategies to be used with SRS to provide an avenue to collect data and adjust teaching. The three strategies are:

1. Contingent/Agile Teaching (Bruff, 2009; Beatty, Gerace, Leonard, & Dufresne, 2006; Draper & Brown, 2004)
2. Discussion Warm-up (Bruff, 2009)
3. Peer Instruction (Bruff, 2009; Mazur, 1997)

Mahon (2012) also identified Peer Instruction, Assessing-to-Learn (A2L) and Deliberate Practice as effective pedagogical practices that can be used effectively with SRS.

Contingent/Agile Teaching. SRS is an effective tool that can facilitate the use of formative assessment in monitoring students' progress and their learning during class sessions. The aim is to find out what they understand, what they do not understand and what perspectives they have on important topics. This information enables lecturers to respond accordingly in the classroom situation. Beatty et al. (2006) named this "agile teaching"; whereas Draper and Brown (2004) refer to it as "contingent teaching". Beatty and Gerace (2009) indicated that agile teaching can be used to make large changes on a minute-to-minute basis, guided by real-time formative assessment evidence. When lecturers practice agile teaching, class time is spent in responding to students' needs (Burff, 2009).

During Contingent/Agile teaching, the lecturer decides how to proceed based on students' responses. The lecturer is presenting ideas, collecting formative assessment data, and adjusting content and teaching strategies based on how well students understand the concepts obtained from the SRS (Brewer, 2004; Draper & Brown, 2004; Elliott, 2003; Greer & Heaney, 2004; Hinde & Hunt, 2006; Jackson et al., 2005; Kennedy & Cutts, 2005; Poulis et al., 1998; Stuart et al., 2004, as cited in Kay and LeSage, 2009). Hence, the content presented and discussed in the classroom is largely dependent on student feedback and this feedback comes in real time from the SRS. This strategy leads to an adjustment to the teaching method based on feedback from the class.

Discussion Warm-up. Monitoring students' progress is one of the main purposes of formative assessment and this can be achieved through the Discussion Warm-up strategy (Bruff, 2009, as cited in Fuller & Dawson, 2017). This strategy is applied when the lecturer poses an initial question to stimulate the students' thinking about the topic. The lecturer then gives the students sufficient time to submit their responses to the question using the

nominated SRS tool. This strategy encourages all students to participate. Besides, it allows students to decide upon a response prior to the discussion and to be critically engaged in the content. SRS generated data helps the lecturer to identify the students' understandings or misinterpretations, if any, and is used to guide the discussion appropriately, as well as to direct future instruction to meet learners' needs (Bruff, 2009, as cited in Fuller and Dawson, 2017).

Peer Instruction. The Peer Instruction strategy (Bruff, 2009a, 2009b; Mazur, 1997, as cited in Fuller & Dawson, 2017) engages the students in an instructional sequence of questioning, peer interaction, and class-wide discussion to help the group understand the material especially when the content is more difficult. For this strategy, once a question is posed, the response data are displayed to the class anonymously. In case there is a significant number of incorrect answers, the class is asked to discuss the question among themselves. The lecturer can arrange for the students to work in pairs for a peer discussion. A student who has answered the question correctly can provide insight. After a few minutes of peer discussion, the students vote again using the SRS.

This kind of interaction engages the entire class and provides formative data to the lecturer that guides the follow-up class discussion. It gives the students an opportunity to discuss with their peers and provide feedback as they respond to the questions that are asked. An extensive survey study by Fagen et al. (2002, as cited in Fuller and Dawson, 2017) detected significant learning gains and engagement among college students when employing this strategy.

Peer-to-peer instruction has been a method of formative assessment promoted in the research literature (Black & Wiliam, 2009). Many researchers like Caldwell (2007), El-Rady (2006), GauAsci et al. (2009), Keough (2012), Mayer et al. (2009), Poirier and Feldman (2001), and Preszler and Dawe (2007, as cited in Walklet et al., 2016) asserted that SRS can

improve achievement, attention to in-class material, motivation to attend sessions, and promote active learning and critical thinking through peer interaction. The literature also indicates that about 80% of lecturers consider peer instruction engagement to be effective in terms of learning gains (Balta, Michinov, Balyimez, & Ayaz, 2017; Fagen, Crouch & Mazur, 2002; Vickrey, Rosploch, Rahmanian, Pilarz, & Stains, 2015, as cited in Petrucco, 2019). Integration of SRS facilitates this collaborative form of instruction because it promotes peer discussion and problems being solved. For instance, SRS can be used to initiate a discussion either for peer instruction or students' discussion on some key responses and then vote again to verify their understanding (Petrucco, 2019).

Assessing-to-Learn (A2L). This strategy asks the students to discuss the questions in small groups first, then enter responses and view results. A2L has question cycles which are the core of the activity. Instruction from the lecturer is only added when needed. Dufresne et al. (2000) claimed that this strategy is a practice to inform lecturers about what their students think, inform students about what their classmates think and inform an individual about what they think (cited in Mahon, 2012).

Deliberate Practice. In this strategy which is implemented by Deslauriers et al. (2011) in their Physics class, SRS questions are used as in-class formative evaluations, followed by discussions and problem-solving. Students are asked to do pre-reading before the class and move the “simple transfer of factual knowledge” outside of class. The class time is spent on working on activities and tasks with feedback from peers and the instructor. During the class time, students are fully engaged to make and test predictions and arguments about the relevant topics, solve problems and critique their own reasoning and that of others.

These are some of the instructional strategies that can be used with SRS when integrated with the process of formative assessment. To effectively integrate technology and implement these instructional strategies into formative assessment practice, lecturers need to

develop a variety of skills and knowledge. The next section explores the knowledge and skills needed for effective implementation of formative assessment and associated technologies.

2.9 Knowledge and Skills Needed for Implementing Formative Assessment Informed by Technologies

Various studies have highlighted the importance of assessment literacy to enable lecturers to use formative assessment in the classroom (Birenbaum, Kimron, & Shilton, 2011; Bryant & Carless, 2010; Gottheiner & Siegel, 2012; Lee, 2011; Lee, Feldman, & Beatty, 2012, as cited in Schildkamp et al., 2020). Schildkamp et al. (2020) explained that assessment literacy includes knowledge and skills regarding the entire assessment process, from collecting information about student learning to making instructional adjustment based on the collected information. They have also stressed the importance of data literacy comprising the knowledge and skills concerning data collection, analysis, and interpretation of collected data. According to Looney (2010), two U.S.-based studies on the impact of using polling devices to facilitate formative assessment practices revealed that it is vital for lecturers to gain the skills needed for setting up assessment situations and for responding to the collected evidence.

As discussed previously, feedback is the pillar of formative assessment. Yet at the same time, it is a demanding task for lecturers to plan for embedding assessments during instruction and for providing feedback and instructional adjustment. It is not only the issue of creating classroom culture, but also a range of knowledge, assessment, and technology expertise is needed. Ball et al. (2008), Heritage et al. (2009), and Shulman, 1986, 1987 (cited in Herman et al., 2015), argued that lecturers need to acquire content-pedagogical knowledge which involves knowledge of developing students' understanding in specific content areas, the difficulties and misconceptions they may encounter in such development, as well as the specific teaching and assessment strategies needed in response to learning needs. The

knowledge and skills needed are that of plan for the instruction, knowing when and how to elicit evidence of student understanding, and analyse and interpret student work, and being able to identify any misconceptions and/or obstacles and know how to take immediate action to close the gap between the current learning level and where students need to be (Heritage, 2010). Gottheiner and Siegel (2012, as cited in Schildkamp et al., 2020) clarified that lecturers need pedagogical content knowledge to determine how to provide feedback to their students and/or adjust their instruction. To illustrate this point, lecturers must have knowledge of common misconceptions within the subject to be able to provide accurate and effective feedback on student learning and achievement. It is also worth stating here that in the case of absence or less foundational content-pedagogical knowledge, lecturers' formative assessment may yield faulty decisions that could delay student progress (Herman et al., 2015).

Since this thesis focuses on the use of SRS as a tool, it is imperative to consider the Technological Pedagogical Content Knowledge (TPACK) framework, to further understand the knowledge required to effectively integrate technology into the classroom. TPACK was proposed by Mishra and Koehler (2006) and it can be defined as the technological knowledge needed when integrating content knowledge with appropriate pedagogical approaches (Brantley-Dias & Ertmer, 2013). It is the knowledge combination of pedagogy, content, and technology and provides a means to achieving technology-enabled learning (Voogt et al., 2013, as cited in Brantley-Dias & Ertmer, 2013). Integrating technology into instruction can best lead to promising results when there is an interaction of content and pedagogy. In other words, SRS is just a tool that cannot function on its own; lecturers need to know when and how to integrate it into the formative assessment process. They need to know how technology is used to implement pedagogy and teach the content according to students' learning needs (Mishra & Koehler, 2008). Therefore, lecturers need to integrate their pedagogical and content knowledge with technology to effectively use formative assessment practices where

technology is involved in the process. Undoubtedly, the way in which formative assessment is practiced influences student learning (Hattie, 2012; Huisman, 2018; Marzano, 2017; Stiggins, 2006). According to the data collected from Huisman's study (2018), the effective implementation of formative assessment leads to enhanced students' confidence and their readiness for examinations.

The next section considers the need for creating a measurement tool that can be used to answer the questions regarding the effectiveness of lecturers' formative assessment that have been raised in this section.

2.10 The Need for Developing a Rubric

There is little doubt that there is an abundance of research that links the effective use of formative assessment to improved student performance. This leads to a number of questions regarding the effectiveness of lecturers' formative assessment practice. If lecturers were asked how effective they are at formative assessment, chances are they would also say that they are very effective. If they were then asked to support that judgement with evidence, what evidence would they produce? It is suggested that most would revert to saying what strategies they use. This does not answer the question. If the question was then extended to ask what evidence can they produce that they are more effective in formative assessment than when they first started lecturing, what evidence would they need to show that they are more effective at formative assessment now than they were?

These are measurement questions and as such there is a need to use measurement tools to answer questions regarding, "how much?" and "how well?" Indeed, a measurement tool is needed to provide supporting evidence that can be used to measure the performance. One possible way this can be achieved is using a measurement rubric. To develop a well-crafted measurement rubric, there needs to be familiarisation with types of rubrics and the requirements of good measurement practice.

The following sections provides examples of rubrics and considers issues of their validity and reliability.

2.10.1 Types of Rubrics

Rubrics are often confused with other kinds of evaluation tools like rating scales and checklists. A rubric is “a coherent set of criteria for students’ work that includes descriptions of levels of performance quality on the criteria” (Brookhart, 2013, p. 4). Brookhart (2018) illustrated that the presence of both criteria and proficiency level descriptions differentiate rubrics from other kinds of evaluation tools like checklists, that ask for dichotomous decisions (Brookhart, 2010). Typically, checklists use ‘has/doesn’t have’ or ‘yes/no’ criteria. Rating scales, on the other hand, ask for decisions across a scale. Rating scales may “include numerical scales (e.g., 1–5), evaluative scales (e.g., Excellent-Good-Fair-Poor), and frequency scales (e.g., Always, Usually-Sometimes-Never)” (Brookhart, 2018, p. 1).

The ultimate purpose of a rubric is to assess performance and there are various types of rubrics that can be used to assess performance (Brookhart, 2013). Brookhart (2013) summarised the types of rubrics, advantages, and their disadvantages according to two aspects of their composition (Table 2.3). The first aspect is whether the components are treated one at a time or together. The other aspect is whether the rubric is general or task-specific. In other words, rubrics are defined in terms of their two main parts: criteria and descriptions of levels of proficiency. The focus of criteria is the learning outcomes, not aspects of the task itself. As for the descriptions of levels of proficiency, they should be descriptions, not evaluative statements (Brookhart, 2013). The next section considers different formats for rubrics.

2.10.1.1 Analytic and Holistic Rubrics. Analytic rubrics are also known as full rubrics (Walvoord, 2010, as cited in Suskie, 2017) or descriptive rubrics (Suskie, 2009, as cited in Suskie, 2017). They describe work on each criterion (component, dimension, trait)

separately. Conversely, holistic rubrics describe the work by applying all the criteria (component, dimension, trait) simultaneously and enabling overall judgment about the quality of the work (Brookhart, 2013). Jonsson and Svingby (2007) explained that holistic scoring provides an overall judgment about the quality of performance, while analytic rubrics are scored in a way that provides a score to each of the criteria (components, dimensions, traits) being assessed in the task.

As demonstrated in Table 2.3, each type of rubric has benefits and shortcomings. Brookhart (2013) suggests that analytic rubrics are appropriate for formative assessment because they make it possible to focus on the criteria one at a time and attribute a score (or code) to each of the criteria. This provides more evidence about the students' performance which is better for instruction and to see what aspects of it need more attention. Jonsson and Svingby (2007) stated that analytic rubrics help to identify strengths and learning needs because they provide detailed feedback against each component/dimension/trait. Despite the benefits of analytic rubrics, there are several shortcomings as are also summarised in Table 2.3. One widely cited shortcoming of analytic rubrics is that they are more time-consuming to create and use than holistic rubrics. In contrast, holistic rubrics are better for large-scale assessments and final summative assessments because there is no need for further information apart from the grade, score or code. Therefore, using holistic rubrics for scoring is faster because there is only one decision to make. However, holistic rubrics can lead to inconsistencies in scoring (Suskie, 2017).

Table 2.3

Advantages and Disadvantages of Different Types of Rubrics (Brookhart et al., 2008, as cited in Brookhart 2013, pp. 7-8)

Type of Rubric	Definition	Advantages	Disadvantages
Analytic	Each criterion (dimension, trait) is evaluated separately.	- Gives diagnostic information to teacher. - Gives formative feedback to students. - Easier to link to instruction than holistic rubrics. - Good for formative assessment; adaptable for summative assessment; if you need an overall score for grading, you can combine the scores.	- Takes more time to score than holistic rubrics. - Takes more time to achieve inter-rater reliability than with holistic rubrics.
Holistic	All criteria (dimensions, traits) are evaluated simultaneously	- Scoring is faster than with analytic rubrics. - Requires less time to achieve inter-rater reliability. - Good for summative assessment.	- Single overall score does not communicate information about what to do to improve. - Not good for formative assessment.
General	Description of work gives characteristics that apply to a whole family of tasks (e.g., writing, problem-solving).	- Can share with students, explicitly linking assessment and instruction. - Reuse same rubrics with several tasks or assignments. - Supports learning by helping students see “good work” as bigger than one task. - Supports student self-evaluation. - Students can help construct general rubrics.	- Less reliability at first than with task-specific rubrics. - Requires practice to apply well.
Task-Specific	Description of work refers to the specific content of a particular task (e.g., gives an answer, specifies a conclusion).	- Teachers sometimes say using these makes scoring “easier”. - Requires less time to achieve inter-rater reliability.	- Cannot share with students (would give away answers). - Need to write new rubrics for each task. - For open-ended tasks, good answers not listed in rubrics may be evaluated poorly.

Rubrics are also classified by use, that is whether they are general or task-specific.

2.10.1.2 General and Task-Specific Rubrics. General rubrics are those where the criteria and descriptions of performance are generalised across a range of tasks. On the other hand, task-specific rubrics are linked directly to the actual task. Task-specific rubrics contain the answers to a specific problem or explain the reasoning students are supposed to use to be awarded the score (Brookhart, 2013; Dawson, 2017). One big disadvantage for task-specific rubrics is that they generally cannot be shared with students because they would give away answers. A third classification for rubrics is whether they meet the criteria for the purpose of measurement.

2.10.1.3 Measurement Rubrics. From a measurement perspective, formative assessment is an inferential process which is like all educational measurements (Bennett, 2011) in that “it involves four activities: designing opportunities to gather evidence, collecting evidence, interpreting it, and acting on interpretations” (Bennett, 2011, p. 16). Bennett (2011) noted that little attention in formative assessment literature has been paid to the third activity, which is interpreting the evidence. Hence, this is another motive for constructing a measurement rubric to fill this gap in literature.

Unlike the rubrics discussed above, the measurement rubric is based on the measurement theory and aligned with the “growth model” which enables evidence of progress to be tracked (Tognolini & Mowbray, 2019). Modern Measurement Theory, which provides an approach to constructing measurements in the social sciences is based on the application of the Rasch Model (Andrich & Marais, 2019; Bond & Fox, 2007; Bond et al., 2020). The Rasch Model has the property of specific objectivity, which means that the measurements are invariant across different tests or tasks measuring the same thing.

Additionally, the measurement rubric that underpins the construction of the scale gives meaning to lecturers’ level of proficiency by comparing the evidence obtained from

lecturers' formative assessment practice and associated technologies to the measurement rubric. This process of giving meaning to evidence by referencing it to a set of pre-determined performance standards or levels of proficiency is referred to as standards-referencing. The model provides a framework for measurement that is based on describing and verifying different levels of proficiency development.

This application of Measurement Theory is well suited to rubrics that require evidence to differentiate performance levels in terms of "how much" of what is being measured. Thus, this type of rubric aligns with the requirement of being able to measure how effective each lecturer is at formative assessment. In this thesis the aim must be to locate the lecturer's practice in applying formative assessment informed by technologies on the measurement rubric. The measurement rubric locates lecturers' performance on a continuum or progression described in levels of proficiency that stretch from no evidence of practice to exemplary practice. The aim is to make on-balanced judgements as to which description of the level of proficiency best matches the lecturers' evidence of their formative assessment practice and associated technologies.

It is worth noting that the development of any good measure requires the collection of empirical evidence, and theoretical rationales that support the adequacy and appropriateness of interpretations made from test scores or other modes of assessment (Messick, 1989). This need is the same for developing a measurement rubric for this thesis. The most important evidence for the valid inference of scores resulting from use of the measurement rubric is related to how much formative practice lecturers can demonstrate via the measurement rubric. Consequently, the content of the measurement rubric needs to be reviewed to provide validity evidence that the resulting scores are aligned with the construct being measured.

One of the major contributions of this thesis is to develop and validate a measurement rubric for evaluating lecturers' effectiveness of formative assessment practice informed by

technologies in the higher education context. Based on the needs of this thesis and the information reviewed about rubric strengths and weaknesses, an analytic, task-specific, measurement rubric will be constructed to help answer the research questions.

The next section considers some of the requirements of good measurement practice when building a measurement rubric.

2.10.2 Validity and Reliability of Rubrics

2.10.2.1 Reliability of Rubrics. Messick (1998) clarified that the major concern of reliability is score consistency or stability. It refers to the agreement of scores garnered from multiple raters. The more consistency there is in scores over different raters and occasions, the more reliable the assessment will be (Moskal & Leydens, 2000, as cited in Jonsson & Svingby, 2007). Rater reliability is the type of reliability that is most considered whether in classroom assessment or in rubric development (Moskal & Leydnes, 2000, as cited in Reddy & Andrade, 2010).

There are various threats to reliability like variation in the rater's (or raters') judgements and task-sampling variability (Jonsson & Svingby, 2007). Variations in judgments may occur due to differences in raters' judgement that can be for all raters which is known as inter-rater reliability. Reddy and Andrade (2010) explained that inter-rater reliability has two approaches: consensus and consistency. Consensus measures if the same score is assigned by raters whereas consistency measures the correlation between the scores of raters. Variation can also occur in the consistency of one single rater which is known as intra-rater reliability (Jonsson & Svingby, 2007).

2.10.2.1 Validity of Rubrics. While evidence of reliability implies that something is being measured, evidence of validity signifies the nature of that something (Messick, 2000). Thus, the major concern of validity is what test scores mean (Messick, 2000). In other words, the major concern of validity is not the test nor the scores, but the inferences and decisions

based on those scores. In its simplest terms, validity refers to “the degree to which evidence and theory support the interpretations of test scores for proposed uses of tests” (American Educational Research Association, American Psychological Association & National Council on Measurement in Education, 2014, p. 11). There are various perspectives and multiple types of validity investigated and reported in the literature on assessment (Jonsson & Svingby, 2007). According to Messick (1995), the traditional concept of validity is divided into three types: content, criterion, and construct validity. However, Messick (1995) argued that this view of validity is fragmented and incomplete. Based on Messick’s (1995) view of validity, the unified concept of validity integrates considerations of content, criteria, and consequences into a construct validity. Messick (2000) noted that the psychometric literature views the fundamental issue of validity as construct validity because the score meaning is a construction that makes theoretical sense out of the performance underlying the score and the relationships with other variables.

Six aspects of construct validity have been identified: content, substantive processes, score structure/structural, generalisability, external relationships, and consequences of testing (Messick, 1989; Messick, 1995; Messick, 2000). These six differentiated aspects of construct validity function as general validity criteria or standards for all educational and psychological measurement (Messick, 1989; Messick 1995; Messick, 2000). Messick (1989) defined validation with an emphasis on the appropriateness of score-based actions and the appropriateness of inferences as “an integrated evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy, and appropriateness of inferences and actions based on test scores or other modes of assessment” (p. 13).

Validation is a process of gathering evidence that can support the inferences and uses of a rubric. Hence, validity depends on the amount and quality of evidence that supports the interpretations and uses of test scores (APA/AERA/NCME, 2014). Validity evidence is the

evidence that comes from various sources, such as test content, response processes, internal structure, relations to other variables, and consequences of the testing, and that supports the adaptation and use of the test for its intended purposes. The joint Technical Standards in Education (APA/AERA/NCME, 2014) describe different sources of validity evidence that can be used to support the interpretations and uses of test scores. These sources of validity evidence are:

1. Validity evidence based on test content: This form of evidence is used to demonstrate that content of the test is congruent with the testing purpose.
2. Validity evidence based on response processes: It refers to any evidence that indicates the intended cognitive processes are being used by the assessment takers.
3. Validity evidence based on internal structure: This form describes evidence of the hypothesised dimensionality (factor structure) being consistent with the theory underlying the assessment. It also includes evidence of measurement invariance, where relevant, across source and target languages and any relevant subgroups.
4. Validity evidence based on relations to other variables: This describes evidence that scores from the assessment display the hypothesised relationships with other variables, in a manner consistent with the construct theory.
5. Validity evidence based on consequences of testing: This form of evidence is used to determine that the intended consequences of the assessment are occurring, and any unintended negative consequences do not occur or are minimised.

It is imperative to note that not all five sources of evidence are needed for every purpose. They may vary in their importance depending on the context and purpose of testing. As such, this thesis has focused on content validity as the most appropriate evidence for the rubric. According to Carmines and Zeller (1979) content validity depends on the extent to which an empirical measurement covers a specific content domain. Generally, in this thesis, content validation refers to the plausibility of the interpretations and the appropriateness of the draft measurement rubric as a tool to measure the practice of technology-based formative assessment in higher education courses. It refers to the degree to which the content of the rubric is consistent with its purpose.

In this thesis, both theoretical and empirical approaches have been used in the collection of evidence supporting the argument that the developed measurement rubric is measuring the construct that it is expected to measure. Consequently, content validity in this thesis is interpreted to include evidence for the relevance and representatives of the developed measurement rubric's content. To illustrate, the aim of content validity in this thesis is to determine the extent to which the potential users of the measurement rubric perceive its content as a complete and relevant measure of formative assessment practice, and associated technologies in the higher education context.

The intention of this thesis is to produce a measurement rubric with supporting evidence that can be used to measure the performance of individual lecturers as this would show their location on the development progression. Lecturers would then use the information in the rubric to identify their next stage of improvement in terms of the proficiency level descriptors in the rubric. The process of progressing lecturers along the measurement rubric would involve them becoming more adept in using and applying the criteria within the measurement rubric. This would involve them having targeted professional development, which is discussed below as a process for improving practice.

2.11 Professional Development Program

Professional development (PD) is a tool that can be used to enhance lecturers' careers and practices. It is defined as “structured professional learning that results in changes to teacher knowledge and practices, and improvements in student learning outcomes” (Darling-Hammond et al., 2017, p. 2). Professional development has been found to be an effective approach for enhancing targeted areas of skills about an instructional practice (Desimone & Garet, 2015; Hill, Beisiegel, & Jacob, 2013, as cited in Kenyon, 2019). Therefore, in relation to this thesis, professional development is considered as an appropriate choice to assist lecturers to develop and expand targeted instructional strategies that may support their practices of formative assessment.

Yang et al. (2014) discussed the importance of providing professional development to alter the culture of feedback provision in classrooms and build a strategy for implementing formative assessment. Likewise, Kenyon (2019) conducted PD sessions to provide support for teachers to consistently implement formative assessment. Jonson (2019) also illustrated that professional development programs could increase the use of formative assessment in the classroom. In the same vein, Al-Amri (2011) recommended staff members' professional development for the art education faculty in Oman's Sultan Qaboos University (SQU) to address assessment issues.

Generally, professional development exists in various forms such as workshops, learning communities, continuing education programs, and action research (Brown & Militello, 2016). Akiba (2012) described different types of PD models: lecturer learning communities, online learning communities, professional learning communities, one-off PD sessions/workshops, college courses, coaching, mentoring, and so forth. Akiba (2012) clarified that professional development activities can be classified as formal and informal activities. However, the most important thing is not about its type or whether it is formal or

informal. The most important thing is its components that form the model or program (Desimone, 2009).

To develop a well-structured development program, there is a need to rely on various core features. Desimone (2009) identified a set of core features of effective professional development: (a) content focus, (b) active learning, (c) coherence, (d) duration, and (e) collective participation. Depending on the purpose of the PD sessions, researchers, however, may tend to apply different approaches for facilitating and assessing PD programs. For instance, Lasica et al. (2020) applied Problem-Based Learning, Inquiry-Based and Contemporary Learning Approach as well as TPACK (Technological Pedagogical and Content Knowledge) as the theoretical framework underpinning the PD program to investigate the impact of augmented reality (AR) on teachers' level of technology acceptance, students' motivation and use of specific 21st century skills. In this thesis, PD functions as a treatment to help lecturers move along the measurement rubric in a way that supports their growth in relation to the effectiveness of their formative assessment practice.

The study location for this thesis is Oman. The next section provides a brief overview of the Omani higher education and its assessment system.

2.12 Higher Education System in Oman

The Omani higher education system has grown significantly since the opening of the first higher education institution, Sultan Qaboos University (SQU), in 1986, with a dramatic increase in the construction of new public and private universities and colleges (World Bank, 2012). Students who pass year 12 in the secondary school progress to higher education. The purpose of the higher education system is to provide the nation with high quality graduates who meet the needs of 21st century workforce, so they have the skills and competencies necessary to be successful (World Bank, 2012).

English is the medium of instruction in most public and private higher education institutions (HEIs) in Oman. However, it is important to note that English is not the medium of instruction at school, yet it is a mandatory subject from the first grade onwards. Arabic is the official language in Oman. Consequently, students are required to complete a foundation program before they commence their undergraduate studies. The aim of the foundation program is to attain the English language skills, Information Technology, Mathematics, and study skills required to perform competently in higher education subjects or courses. The use of English as a medium of instruction in the HEIs is based on policymakers' beliefs that English is required for the country's modernisation, technological advancement, and continued integration into the modern world (Al-Mahrooqi & Tuzlukova, 2010, 2012).

It is important also to mention that the Oman Academic Accreditation Authority (OAAA) has the responsibility to regulate the quality of all higher education institutions (Al'Abri, 2019). Al'Abri (2019) added that OAAA is assigned to do institutional and program accreditation as well as develop the national qualifications framework.

2.13 Assessment System in Higher Education in Oman

The education system in higher education institutions (HEIs) in Oman is deeply committed to strengthen student competencies in mathematics and science, to improve student proficiency in English, so that they have the desired diverse skills and knowledge. Nevertheless, to evaluate the effectiveness of these skills and knowledge in the new curriculum, it is imperative that student assessments be reformed as well (Alsarimi, 2001).

In Oman, standardised tests (mid-term and final examinations) are considered as the only reliable tool for assessing student knowledge and academic progress, and are used as the dominant measures of achievement (Denman & Al-Mahrooqi, 2018). In addition to the standardised tests, Denman and Al-Mahrooqi (2018) noted that various forms of alternative assessment techniques, such as Moodle activities, portfolios, projects, presentations, and role-

plays, have been used in Oman's HEIs and these forms of alternative assessment are called "continuous assessment". Many HEIs introduced continuous assessment systems besides summative assessments. Continuous assessment aims at providing frequent analysis of the learning performance that make strong links between teaching, learning, and assessment. Based on this assessment system, lecturers are expected to use a variety of assessment methods like quizzes, presentations, projects, etc. (Denman & Al-Mahrooqi, 2018). Al-Mahrooqi et al. (2015) illustrated that much of student work is assessed through continuous assessment that tend to be subjective and may vary in quality across institutions. These forms of assessment are graded and tend to be linked to formal examinations such as high stakes exams despite the current development of a continuous assessment system (AlKharusi et al., 2014). So continuous assessment is used in a summative way. In this regard, using continuous assessment in a summative way cannot provide clear information about students' progression of their learning. These studies reveal ample evidence that there is a need to change the lecturers' knowledge about the purpose of assessment, particularly the formative kind and to provide them with an accessible tool to measure their own practice.

2.14 Summary

Chapter 2 has reviewed the selected literature with a focus on several areas linked to formative assessment and integration of technology in the higher education context. It provides a description of formative assessment, strategies used in formative assessment and a historical background and context for the conceptualisation of formative assessment, as well as the integration of technology into formative assessment practice. Furthermore, it shows that by identifying the key components and the process of formative assessment, this makes it possible to view how a measurement rubric can be structured and how relevant professional development can be characterised. The next chapter explores the research framework used to guide this thesis.

Chapter 3: Research Framework

3.1 Introduction

This chapter describes and explains the theoretical and conceptual theories used in this thesis. Formative assessment does not have its own theory of learning or language acquisition. Wiliam (2010) stressed that formative assessment is not necessarily associated with a specific theory of learning. However, when developing a theoretical framework for formative assessment, many researchers use constructivism as a descriptive theory for its foundation (Anthony, 1996; Black & Wiliam, 2004; Brookhart, 1997; Pryor & Torrance, 1997, as cited in Heitz, 2013). According to Heitz (2013), Von Glasersfeld (1996) defined constructivism as a theory that “provides a model of cognition that leads directly to a method of teaching that credits the student with the power to become an active learner” (p. 25). Constructivism, then, is not a theory about teaching but a theory about how students learn (as cited in Heitz, 2013). To put it more simply, constructivist teaching helps students to make sense of what they are learning, fosters their critical thinking and motivates them as independent learners.

3.2 Theoretical Framework

The aim of formative assessment, based on this view of constructivism, is to inform deliberations and decisions on how to help the student to learn. It is basically to understand what the student can do or cannot do and what they must do next. In such situations, students are actively involved in constructing their own knowledge through experience and problem-solving. By considering the components of formative assessment as described in the definition used in the previous chapter, the uses of SRS and the integration of SRS which relies on active learning approaches (e.g., collaboration, group work, and peer- or lecturer-guided discussion and feedback), formative assessment enhanced by SRS is obviously within

the realm of constructivism. More specifically, it falls into a sociocultural constructivist view of learning.

Sociocultural theory is used to describe and understand how students learn through different social means and interactions. Instruction, therefore, is designed to be a collaborative environment for students to learn in the zone of proximal development (ZPD) (Wu, 2019). Sociocultural theory which grew out of the work of seminal psychologist Lev Vygotsky (1978) is also known as the Vygotsky theory. However, as cited in Heitz (2013), Vygotsky's theory has several names in the literature, including but not limited to, "sociocultural constructivism" (Schunk, 2008, p. 242), "social-cognitive constructivism" (Oxford, 1997, p. 43), "Vygotskian constructivism" (Green & Gredler, 2002, p. 57), "social constructivism" (Von Glasersfeld, 1995, p. 141), and "Cultural Historical Activity Theory" (Black & Wiliam, 2009, p. 9; Pryor & Crossouard, 2008, p. 10).

Vygotsky's theory is deemed to be one of the most influential ones for constructivist, whose theories focus strongly on social forces (Heitz, 2013). Many current conceptualisations have roots in a sociocultural constructivist view of learning (Heritage, 2010; Wiliam, 2010, as cited in Muslu, 2017); adopting a sociocultural perspective for formative assessment may help to create an environment that supports student participation and improvement of student learning. It also maximises student learning capacity, and autonomy (Cowie et al., 2013). Vygotsky's theory of learning has had a deep impact on teaching and learning and has become well-known for its emphasis on social interaction. Vygotsky believed that the development of children is advanced through social interaction with other people. According to sociocultural perspectives, cognitive development is largely influenced by social interaction. In the same vein, building relationships between both lecturers and students and among students, has the potential to shape the students' learning process. Henderson et al.

(2018) noted that such interaction can create a learning environment with a culture for interactive and dialogic feedback.

Earlier researchers stated that sociocultural learning theories are different from earlier theories in terms of emphasising the social and cultural aspects of learning (Wertsch, 1991; Wenger, 1998; Lemke, 2001, as cited in Muslu, 2017). Thus, conducting assessment with a sociocultural lens supports open-ended performance tasks that provide students with various opportunities to interact with each other, exchange their experiences to make informed decisions, and act on them accordingly. Shepard (2000) asserted that by applying sociocultural theory, students can solve complex problems and apply their knowledge in real-world contexts.

As noted earlier, Vygotsky (1978) introduced the concept of the zone of proximal development (ZPD) to better understand how students develop understanding. The ZPD is:

The distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem-solving under adult guidance, or in collaboration with more capable peers (Vygotsky, 1978, p. 86).

Ramaprasad (1983) related this gap (or ZPD) to feedback which he defined as “information about the gap between the actual level and the reference level of a system parameter which is used to alter the gap in some way” (p. 4). Sadler (1989) refined Ramaprasad’s definition further proposing his theory of formative assessment. Sadler stated in relation to feedback, that “information about the gap between actual and reference levels is considered as feedback only when it is used to alter the gap” (p. 121). It is therefore not enough for lecturers to merely provide information to students about whether their answers are right or wrong; otherwise, this would be simply be tantamount to summative assessment.

3.3 Conceptual Framework

A conceptual framework is needed to focus on the different components of formative assessment that are related to the problem statement (Ravitch & Riggan, 2017). Laud and Patel (2013) described the conceptual framework of formative assessment as one with various practices that include not only a collection of assessment data to inform teaching and learning, but also the related practices that guide which data to collect and how to use these data. They added that these related practices were originally proposed by Sadler (1989).

Wiliam (2010) defined the formative assessment framework as describing the way that lecturers or students use assessment data to make decisions about next steps. Black and Wiliam (1998) built their research and references on Sadler's (1989) framework. Sadler (1989) focused on the feedback loop, whereas Black and Wiliam (1998) concentrated on the classroom context. As illustrated earlier in Table 2.1, Wiliam and Thompson's (2007) conceptual framework founded on the three key instructional processes. They proposed that formative assessment compromises "five key strategies" and "one big idea" considering the roles of lecturers and students themselves. Heritage (2010) also developed a process of formative assessment, in the form of a cycle, which provided an in-depth guide to implement formative assessment in a classroom.

The proposed process of formative assessment enhanced by student response system (SRS), which is framed as a cycle, has identified the key components of formative assessment that can be the basics of structuring the measurement rubric which is the framework of this thesis. This will also enrich the content of the professional development program that will be conducted during the study's stage 3. The process of formative assessment will capture the steps of a formative assessment process enhanced by SRS starting with articulating learning goals to closing the gap and moving learning forward. The intention of this thesis is to provide lecturers with a practical guide to develop their use of formative assessment

enhanced by SRS and improve their own instructional practices through understanding their students' learning, identification of strengths, diagnosis of weaknesses and areas of improvement. In turn, it will support students in exploiting the feedback received to improve and take control of their learning and eventually become lifelong learners.

The guiding questions in the process proposed by Wiliam and Thompson (2007) put more emphasis on tracking the learning process only (e.g., where the learner is going); however, formative assessment is concerned with informing both the teaching and learning processes. In this regard, the three guiding questions in this proposed framework are: (1) where are the lecturer and students going?, (2) where are the students right now?, and (3) how do lecturers and students get to the learning objective?

As Figure 3.1 suggests, the process of formative assessment enhanced by SRS starts from the top left with lecturers identifying the learning goals and criteria for success which end with closing the gap. To answer the question: "Where are the lecturer and students going?", the former must share learning goals and success criteria with their students before the lesson begins so that what and why something is being learnt, is understood. Lecturers must first clarify the learning goals for themselves and then follow that by establishing criteria for success. Learning goals clarify what students will learn during the lesson(s), whereas success criteria identify "what it takes to meet the learning goal and are used as checks on learning" (Heritage, 2010, p. 11).

support learning and help students make connections during the lesson(s) along with a learning progression. When students are familiar with learning goals, they are better able to assess their own work and the work of their peers toward the desired learning goals. Once learning goals are identified and communicated to the students, lecturers and students assess current understanding and then track progress toward the identified learning goals (Looney, 2010).

Eliciting and interpreting evidence of student learning as well as identifying the gap, will help to answer the question: where are the students right now? With the availability of SRS tools, lecturers can use a variety of techniques and questioning strategies, whether planned or unplanned, to elicit evidence of how students' learning advances toward a goal; to explore students' thinking, and identify possible gaps or misconceptions; to then deepen their understanding and strengthen their ability to transfer knowledge to new situations. Answering the question, 'how do lecturers and students get there?', requires adapting and responding to their learning needs. Both lecturers and students make instructional and learning decisions to close the identified gap(s). Several instructional strategies are suggested to meet the students' learning needs.

3.3 Summary

A theoretical and conceptual framework has been discussed here in the light of the literature to draw a map that provides the impetus for building the measurement rubric which will set the direction of this study. The next chapter outlines the methodology that will be applied to address the research questions.

Chapter 4: Research Methodology

4.1 Introduction

This chapter outlines the research methodology that was used in this thesis. It explains the design, data collection methods and data analysis techniques that were employed to answer the research questions. As noted previously, this thesis employed a sociocultural constructivist view of learning that has shaped the theoretical framework underpinning the practice of formative assessment and associated use of technology in its implementation. The aims of the thesis are:

- (1) To determine how much formative assessment is being carried out in the English language Centre (ELC) at the University of Technology and Applied Sciences (UTAS-Ibri), Oman and how technology is used to support this practice.
- (2) To determine how well lecturers in this Centre use formative assessment and associated technologies in their teaching practices.
- (3) To ascertain the extent to which a professional development (PD) program, targeted at improving the understanding and use of technology-based formative assessment in higher education classrooms, can lead to improved understanding and practice of formative assessment.

The chapter begins with an overview of the research design. Following that, the chapter explores the methods used to collect data including the description of how participants were recruited for the study. The various stages that were taken to explore in-depth changes in lecturers' understanding and practice of formative assessment practice informed by technologies after receiving a professional development (PD) program are also explored. The chapter then elaborates how the data were transcribed, coded, and analysed. It concludes with a discussion of how the credibility of the study was enhanced and how ethical considerations were considered.

4.1 Research Design

A mixed-mode research design was used in this thesis to leverage both qualitative and quantitative data to gain reliable and actionable measures to answer the research questions. The data were collected through a focus group discussion, semi-structured interviews, classroom observations protocols that applied the measurement rubric, field notes, and post-observation discussions. The thesis was guided by the following four questions:

RQ1: What are the key components of effective formative assessment practice informed by technologies?

RQ2: How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?

RQ3: How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?

RQ4: To what extent do lecturers who have undertaken a Professional Development program targeting technology-based formative assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?

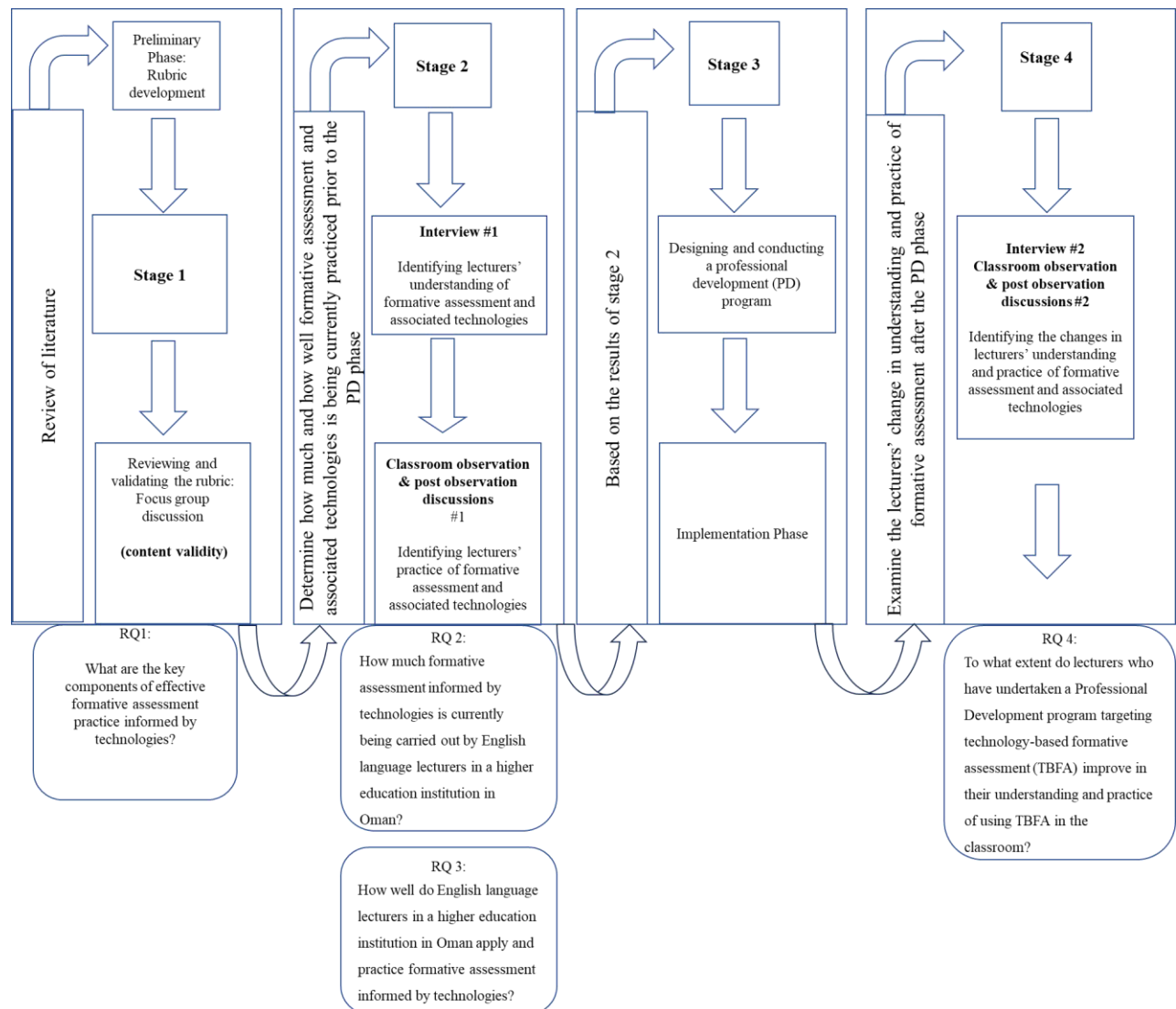
Four stages addressed the thesis four questions. A measurement rubric was drafted during the preliminary phase before collecting data and then a focus group discussion during Stage 1 was used to build an evidence-based argument to validate its design. The measurement rubric enabled the research questions to be answered using comparative analyses carried out at different times on the same construct.

Research question 1 was investigated during Stage 1. Stage 2 addressed research questions 2 and 3. Stage 3 included the administration of a professional development (PD) program. In stage 4, the study addressed research question 4. The research methods included a focus group discussion, lecturer interviews, and classroom observations. The collected data

were coded, themed, and analysed. In view of this, the study's research design, which was interwoven with the research procedure is conceptualised in Figure 4.1.

Figure 4. 1

Research Design and Procedure



4.2 Research Setting

The study was conducted at UTAS-Ibri, one of the campuses of University of Technology and Applied Science (UTAS) in Oman. UTAS is a branch-based Higher Education Institution (HEI) with 13 campuses located in different parts of Oman with about 50,000 students. UTAS is the largest HEI in Oman, a merger of the former Colleges of

Technology (CoTs), former Colleges of Applied Sciences (CAS), and former Rustaq College of Education, by virtue of Royal Decree (76/2020) (<https://www.utas.edu.om/>).

4.3 Participants

Those who participated in this study were English Foreign Language (EFL) lecturers at the English Language Centre (ELC) from UTAS-Ibri. Six participants were engaged in Stage 1 in collecting evidence regarding the validity of the proposed draft of the measurement rubric. They were involved in a focus group discussion (Appendix C). These six participants met the participant recruitment criteria set in the Participant Information Statement (PIS) (Appendix E). These requirements are: (1) having more than five years' teaching experience in higher education; (2) having theoretical and practical knowledge in assessment, instructional design, and technology; and (3) agreeing to participate in this study voluntarily. Four were females and two were males and their teaching experience ranged from 7 to 25 years. Table 4.1 presents demographic information for the participants in Stage 1 (Focus group).

Table 4.1

Demographic Information for Participants (Stage 1)

Participant	Gender	Academic Qualification	Years of Teaching Experience
A	M	PhD	25+
B	F	MA	12
C	M	MA	7
D	F	MA	15+
E	F	MA	10+
F	F	MA	10+

For Stages 2-4, twelve lecturers voluntarily agreed to participate. These participants had to fulfil the following criteria: (1) have experience in teaching and learning in higher education; and (2) have experience using technology and educational assessments. They were mostly females (9 females as compared to 3 males). Most of the participating lecturers in stages 2-4 had teaching experience ranging from 10 to 25 years. The demographic information in Table 4.2 presents details about those lecturers who participated in stages 2-4.

Table 4.2

Demographic Information for Participants (Stages 2-4)

Participant	Gender	Academic Qualification	Teaching Years of Experience	Teaching Delivery Mode
P01	M	MA	30	On campus
P02	F	MA	20	On campus
P03	M	MA	15+	On campus
P04	F	MA	10	Online
P05	F	MA	17	Online
P06	F	MA	5	Online
P07	F	MA	15+	On campus
P08	F	BA	7	On campus
P09	F	PhD	18	On campus
P10	M	MA	27	Online
P11	F	MA	11	Online
P12	F	MA	11	Online

4.4 Data Collection Methods and Procedures

The data for this thesis were collected from various sources: focus group discussion, individual interviews, classroom observations, field notes and post-observation discussions.

As shown in Table 4.3 the study took place over four stages across a 13-week period which lasted from September 2021 to December 2021.

Table 4.3

Summary of Data Collection Methods and Procedures

Stage	Data Collection Method	Duration of Data Collection	Number of Participants/observed classes	Research Questions
Preliminary Phase Development of the draft measurement rubric	Literature Review	-	-	
Stage 1 Collection of Content Validity Evidence	Focus Group Discussion (Review and collection of evidence to validate the draft measurement rubric)	Week 1-3	6 participants	RQ1: What are the key components of effective formative assessment practice informed by technologies?
Stage 2 Pre-PD Phase	Interview #1	Week 4 & Week 5	12 participants	RQ2: How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?
	Class Observation #1 Post-observation discussion	Week 5	4 classes	RQ3: How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?
Stage 3 Design and construction of PD program	PD Program	Week 5 & Week 6	12 participants	
Implementation Phase		Week 7- Week 11	12 participants	
Stage 4 Post PD Phase	Class Observation #2 Post-observation discussion #2	Week 12	8 classes	RQ4: To what extent do lecturers who have undertaken a Professional Development program targeting technology-

Interview #2	Week 13	12 participants	based formative assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?
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The first stage of data collection was a focus group discussion used to collect content validity evidence of the initial draft of the measurement rubric. The second stage comprised conducting interviews and observing classes. The participants then attended a tailored professional development program during the third stage followed by an implementation phase. The fourth and last stage was dedicated to conducting classroom observations and interviews to ascertain whether there had been any change in the participants' understanding and classroom practice of formative assessment practice informed by technologies after receiving the PD program. The field notes (Appendix O) taken during classroom observations and the post-observation feedback forms (Appendix N) that were filled in provided further sources of data for building the evidence. The next section provides details about each source of data collection.

4.4.1 Focus Group Discussion

To collect validity evidence for the draft measurement rubric, the researcher held a focus group discussion with six participants from the English Language Centre (ELC) at the University of Technology and Applied Sciences (UTAS-Ibri), Oman.

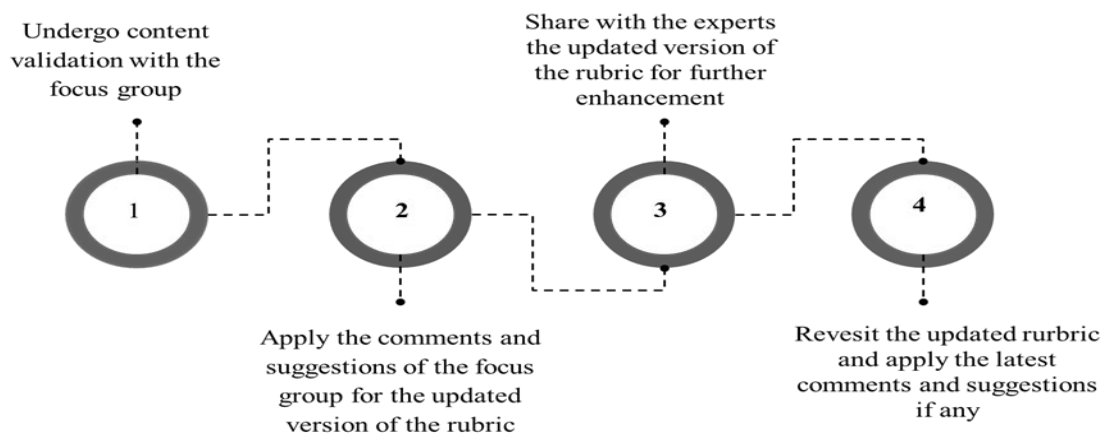
Open-ended questions were asked to promote discussions about different aspects of the draft measurement rubric. The discussion which lasted for two hours was recorded and later transcribed. During the focus group discussion, participants evaluated the content and determined whether they agreed or disagreed with the definition of the construct, the descriptions for each level of proficiency for each component, and the levels of proficiency, approving or disapproving the content. Relevant evidence was gathered to determine if the

content of the rubric fairly and adequately represented key aspects and components of formative assessment.

Based on the focus group recommendations, further modifications were carried out. Following that, the researcher sent via email the edited version of the redrafted measurement rubric back to the participants for further suggested enhancements. However, no feedback was received which enabled the researcher to believe it is the final revision for the measurement rubric. Figure 4.2 illustrates the steps of the validation process for the draft measurement rubric.

Figure 4.2

Steps of the Draft Measurement Rubric Content Validation Process



4.4.2 Interviews

One of the most important sources of data collection was a set of semi-structured interviews conducted during Stage 2 and Stage 4. By applying a semi-structured interview protocol (Appendices K and L), the researcher conducted interviews of 12 English Foreign Language (EFL) lecturers from the University of Technology and Applied Sciences (UTAS-Ibri), Oman. Interviews that were conducted during Stage 2 made it possible to: (a) gain a deeper understanding of what participants believed about formative assessment practice informed by technologies; and (b) gather perceptions that were used to further inform the

effectiveness of the professional development program. At the end of the study, Stage 4, interviews were conducted with the same participants to determine if there had been any changes in the participants' understanding of formative assessment informed by technologies after receiving the PD program. The researcher audio-recorded and later transcribed each interview session, then constructed a comparison of the initial and final interview data as they were related to the participants' involvement in the professional development sessions. The interviews ran for 20 to 40 minutes and were recorded using software on an iPad with an iPhone as a back-up.

Although a list of questions was prepared in advance, further questions were sometimes asked to obtain more information and insights from participants' responses, opinions, and subjective experiences. The total set of questions informed the 2nd research question: "How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?" While the 4th research question was: "To what extent do lecturers who have undertaken a Professional Development program targeting technology-based formative assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?"

Caution was applied during the initial interview to identify the participants' needs for each component of the formative assessment process so that they could be addressed during the professional development (PD) program. The purpose of the interviews conducted at the end of the study was not to test the information gained during the PD program, but rather to collect further evidence, along with the observation data and the measurement rubric regarding changes to their understanding and practice using formative assessment informed by technologies after receiving the PD program. Some questions were added to the interview conducted toward the end of the study to seek further suggestions on how to improve both the measurement rubric and the professional development program.

As previously stated, each interview was audio-recorded and later transcribed. After the initial transcription, the researcher listened again to the recording while reading the transcript to ensure its accuracy. Then, the coding process started by sorting the raw data. A second review of the transcripts was done after the initial coding to allow further codes to emerge. Once the second round of the coding process was finalised, the transcripts were compared to identify the themes that are taken up in the next chapters.

4.4.3 Professional Development Program

The researcher developed and presented a focused professional development program that consisted of four sessions (Appendix P). The program lasted for two weeks as each session was for two hours. The sessions focused on describing formative assessment practice with an emphasis on the integration of the technology. Participants were coached on how to implement formative assessment into classroom instruction informed by technology integration. The researcher crafted the sessions based on the study's theoretical and conceptual framework, and the data collected from the pre-PD phase that included interviews and classroom observations. The sessions were crafted and narrowly focused on the components of the formative assessment process that provided strategies and techniques to be implemented in the classrooms based on the participants' needs.

Furthermore, these sessions were designed to possess many characteristics of successful professional development that have been identified by Desimone (2009) and discussed in Chapter 2 of this thesis. It is imperative to know what to exactly include in a professional development program so that support for lecturers' implementation of formative assessment is properly and successfully understood and implemented (Andersson, 2015).

The participants then were given the opportunities to implement what had been addressed in the PD, into their classroom instruction. During this implementation phase, they used the measurement rubric to self-evaluate their own practice. To help the participants

either self-evaluate their own practice or support a peer in the process of review and reflection, guidelines were provided during the last session of the PD. Having a measurement rubric and not knowing how to use it would be of little value, particularly, if they were not experienced on using rubrics as a measurement tool. The purpose of providing guidelines was to consistently assess the practice of formative assessment informed by associated technologies using the measurement rubric.

The measurement rubric is intended to orient the lecturers to follow the assessment criteria through the formative assessment components and the proficiency level descriptors. An in-depth reading of the measurement rubric is required before engaging in any classroom activity. This allows the lecturers to get a clear picture of what effective practice might look like, relative to the level descriptors that define each of the components. Table 4.4 outlines the topic for each PD session with the accompanying learning objectives covered in the sessions. Each session was divided into two parts with a break in between. A detailed agenda of each session is described in Appendix P.

Table 4.4

Professional Development Sessions: Topics and Objectives

Session No.	Session Title	Session Objectives
		By the end of the PD session, lecturers will be able to ...
1.	Where are we going?	1. Define formative assessment, its purpose and benefits. 2. Differentiate between formative assessment and summative assessment. 3. Identify the key components of formative assessment. 4. Share and communicate learning goals to students.

2.	Where are we now? Identifying gaps in student learning.	1. Elicit, interpret and use evidence of student learning. 2. Identify gaps in student learning. 3. Use different instructional strategies to elicit evidence of student learning.
3.	How to get there?	1. Provide effective and constructive feedback to students. 2. Identify various strategies to adjust instruction and close the gap in student learning.
4.	Putting it into practice.	1. Integrate technology into FA practice. 2. Use different online platforms to conduct FA. 3. Use the developed rubric to self-evaluate your FA practice.

4.4.4 Classroom Observations

Classroom observations were conducted twice during this study as shown in the sequence of the data collection (Figure 4.1). The first set of classroom observations was conducted during Stage 2. They addressed Research Question 3: “How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?” The performance of the participants based on the classroom observation data is linked to the measurement rubric by referencing the evidence to the best matched proficiency level descriptor in the measurement rubric. The same procedures were followed for the second set of class observations that were conducted during the last stage (Stage 4) and contributed to answering Research Question 4: “To what extent do lecturers who have undertaken a Professional Development program targeting technology-based formative assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?” The measurement theory references the evidence from each lecturer on each occasion onto the measurement rubric. In this way, the performance of each

lecturer is compared to their previous performance. The focus is on monitoring the progress of individual lecturers rather than focusing on the mean performance of the group.

The classroom observations provided evidence as to how well the participants applied and practised formative assessment prior to and after receiving the PD program. In addition, these observations provided the researcher with insights into how lecturers in Oman used formative assessment and associated technologies to elicit and interpret evidence of student learning, adjust instruction, and close the gap in student learning and expectation during their daily classroom instruction. The classroom observation protocol (Appendix M) aligned with the measurement rubric to enable specific behaviours associated with each component to be identified and then used to locate the performance of each lecturer along the measurement rubric. Formative assessment practices that were evident through a range of sources including verbal communication, and body language, and the use of technology were observed and recorded using field notes.

These field notes (Appendix O) included the settings and direct quotations obtained from the observed classrooms and which were then consolidated into one protocol after post-observation discussions. To locate the participants on the measurement rubric, the evidence collected from classroom observation was compared with the descriptions of the different levels of proficiency on the components comprising the measurement rubric. In other words, the evidence from the classroom observations was used to find the matching level of proficiency on the measurement rubric using pairwise comparison. The evidence supporting their locations on the measurement rubric provide a reference frame that can be used to monitor and enhance formative assessment practices.

The participants volunteered to have their lessons observed. Prior to the observation, the lecturer provided a summary of the lesson plan to be observed, its main objectives, and procedures. Two sets of classroom observations were conducted. Four classes were observed

during set one of classroom observations (Stage 2) which is prior to the PD phase. Two classrooms were observed on campus and the other two were observed by watching a recorded class on Microsoft Teams. The second set of classroom observations (Stage 4) involved eight classes. The purpose of the classroom observations in Stage 2 was to ascertain lecturers' current use of formative assessment. In Stage 4, the focus was very much on observing the changes, relative to the measurement rubric, that occurred following the implementation phase after the PD program. Each classroom observation was based on one class period which was 1 hour and 40 minutes. Classroom observations allowed the examination of formative assessment practice in a real classroom setting and then these results were combined with data collected from interviews. In summary, classroom observations provided a live experience to uncover the lecturers' practices and ascertain their level of implementation of formative assessment and associated technologies in their real-world context in relation to the measurement rubric.

4.4.5 Post-observation Discussions

Post-observation or follow-up discussions were conducted within 48 hours of each classroom observation session. The purpose of these discussions was to debrief and discuss the corresponding rating of each component on the measurement rubric. These discussions also sought to collect evidence that might not have been obvious during the classroom observation and to be aware of any instructional adjustments that may not have been directly observable. Where it was also not possible to collect all the related evidence to support some of the assigned components in the measurement rubric; the post-observation discussions were able to facilitate discussion, reflection and provision of feedback on such components. Furthermore, post-observation discussions revealed some potential areas for future focus of professional development sessions and also provided suggestions for improving the professional development sessions in the future.

4.5 The Role of the Researcher

Since this thesis dealt with various sources of data, the role of the researcher was diverse, such as developing and administering the draft measurement rubric, and developing interview protocols, observation protocols, and professional development sessions, taking into account the relevant literature. Ideally, several observers would have been used to collect the evidence. However, given the scope of the study, the method primarily builds and measures participants' formative assessment practice informed by technologies. Hence, classroom observations and evaluations were done by the researcher. As such, there is no evidence to support consistent interpretation of the data collected.

The researcher also developed and presented the professional development sessions. Thus, the researcher was the main instrument of the study, collecting, analysing, interpreting, and discussing all the sources of data. All the participants knew the purpose of the study and their role as participants prior to their participation in the study. The guidelines provided during the interviews and the observation protocols allowed the researcher to stay focused on what to look at and in so doing, attempt to minimise her influence on the data collection. Further ways that the researcher tried to maximise the reliability and validity of the data collection include:

1. During classroom observations, the researcher never participated in the activities that were held within the classroom. Field notes were taken, photos and video recordings of the sessions were also captured to document the details needed for the study. The interviews and classroom observation protocols specified what to look at and this made it helpful in eliminating the risks that could have influenced the results or led to any bias.

2. To avoid misinterpretation of the data, the researcher maintained detailed notes on data collection procedures, details of interviews, observations, the sessions of the professional development program and the participants.
3. Thoughts and concerns related to data analysis were also documented.
4. To maintain integrity and fully explain the process, the researcher thoroughly documented the data collection and analysis procedures.

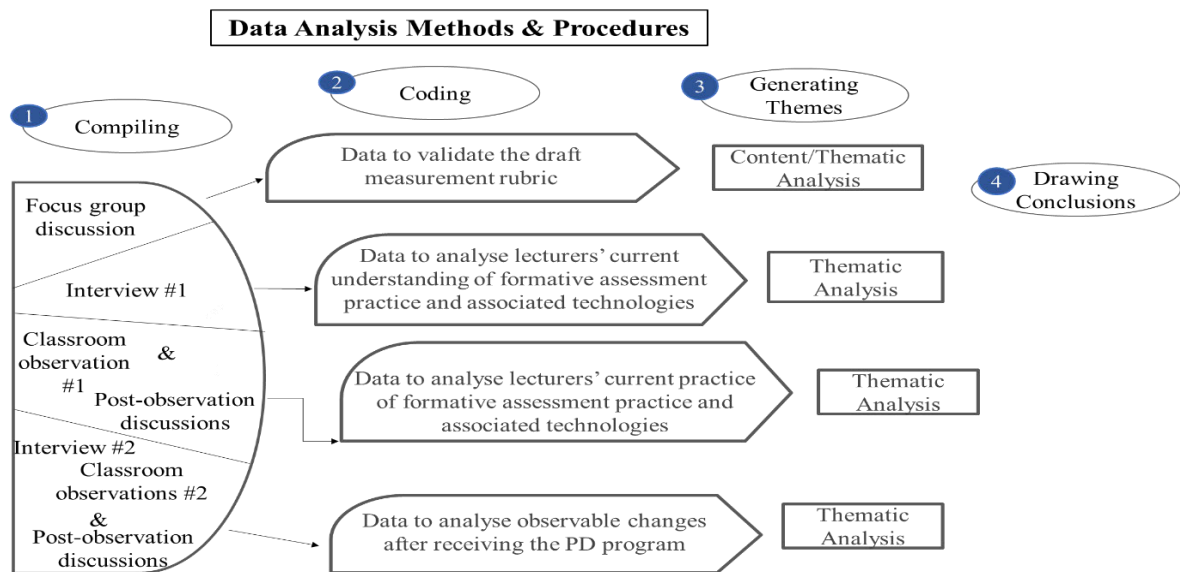
The next section discusses the methods and procedures used to analyse the data collected.

4.6 Data Analysis Methods and Procedures

All the data sources were analysed through content and thematic analysis. Figure 4.3 summarises the data analysis methods procedures used in this thesis.

Figure 4.3

Summary of Data Analysis Methods and Procedures



Qualitative content and thematic analysis served to analyse the qualitative data collected during this phase of the study. Braun and Clark (2006) described thematic analysis as “a method for identifying, analysing, and reporting patterns (themes) within data. It minimally organises and describes your data set in (rich) detail” (p. 6). Hence, reporting

patterns, called themes, are the main product of data analysis that yield results in the field of study.

Inductive analysis was used to generate the results from the qualitative data such as interviews and observations. As stated in Kekeya (2016), inductive analysis is an iterative process that aims to sort and order qualitative data such as interviews and observations (Cohen, Manion, & Morrison, 2011; Creswell, 2009; Punch, 2009). Kekeya (2016) illustrated that by using the process of iteration, the researcher repeatedly revisits the data to unveil results. Considering various methods, the researcher followed this process for data analysis: (1) compiling data, (2) coding data, (3) generating themes, and (4) drawing conclusions.

4.6.1 Compiling Data

During the initial phase of data analysis, the researcher compiled and sorted all data from focus group discussion, interviews, observations, field notes and post-observation classroom discussions.

4.6.2 Coding Data

The compiled data were broken down into smaller units and the researcher assigned new codes to these smaller units. Merriam and Tisdell (2016) referred to this initial coding of data as open coding. Merriam and Tisdell (2016) illustrated that coding is the process of “making notations next to bits of data that strike you as potentially relevant for answering your research questions” (p. 2014). During the coding process, all the sources of data were analysed inductively using coding strategies that were described by Creswell (2013). The coding process started with open-coding in which the researcher coded the data for its main categories of information. Inductive open-coding allowed the researcher not to rely on pre-set codes but rather to develop and modify the codes as working through the coding process. Essentially, the researcher was continuously going back and doing further coding rounds based on codes and categories derived from each step.

The researcher then reorganised the codes into different groupings and sequences by comparing, modifying, and restructuring codes into broader groups and grouping the codes into categories.

4.6.3 Generating Themes

In this step, the researcher connected all the codes that are related to each other into one core category, one theme. In other words, the outcome is that each theme is a group of codes that are related to each other.

4.6.4 Drawing Conclusions

The final step of the data analysis process involved drawing conclusions. Yin (2015) indicated that such conclusions should be linked to the interpretation of data, which involves making sense of all the information and drawing conclusions or implications from them. Although these phases are laid out sequentially, Yin (2015) illustrated that the analysis is more likely to occur in a nonlinear way. It involves going back-and-forth between the steps more than once.

4.7 Credibility of the Study

According to Yin (2015), credibility means providing assurance that the researcher has collected and interpreted the data properly, so that “findings and conclusions accurately represent the world that was studied” (p. 85). This means that credibility establishes the extent to which the research findings represent and interpret plausible information drawn from the collected data. Yin (2015) suggested four ways to strengthen the credibility of a study: (1) trustworthiness, (2) triangulation, (3) validity, and (4) rival thinking. Although credibility can be strengthened after data collection has taken place, it is important to consider dealing with the sources of credibility during the design of the study (Yin, 2015).

4.7.1 Trustworthiness

The process of triangulation can strengthen the trustworthiness and credibility of the results and conclusions of a study, as stated by Yin (2015). Consequently, the researcher thoroughly described the selection of data collection methods, study site and participants as well as specifying in detail how the researcher approached data selection. The transcribed data were also sent back, via e-mail, to the participants to enable them to check the accuracy of the transcriptions and to change them where required. This stepwise process increased the chances of more accurate findings being obtained. The hard and soft copies of all the data sources have been filed and are available upon request. The audio recordings and transcriptions are also available, if needed.

The authenticity of the work was demonstrated by the participants as they checked for accuracy, the representation of themselves whether during the interviews or classroom observations. Prolonged engagement was also achieved through ongoing observations that allowed the researcher to gain a better understanding of the local culture of the studied area, and to detect any misunderstanding that may possibly arise, make decisions related to the focal points of the study, and contextualise what was being studied.

4.7.2 Triangulation

The credibility of the results was increased further through triangulation. Triangulation of data for this study was achieved by collecting data from multiple and varied sources that included focus group discussion, lecturer interviews, classroom observations, post-observation discussions, and professional development sessions. Triangulation helped to strengthen the level of confidence in the evidence, but also to obtain a more comprehensive and a deeper understanding of the investigated study. This consequently should lead to more robust and well-developed research findings. Maxwell (2013) considered data triangulation as a strategy to strengthen validity in qualitative research. To maximise the reliability and

validity of the results of this study, the data collected from the interviews were compared with data collected from classroom observations and post-observation feedback discussions with the participants. Moreover, transcripts of the interviews and the focus group discussion were sent to the participants for conformation. Hence, the different sources of data retrieval created a triangulation of findings.

4.8 Ethical Considerations

Ethical dilemmas are likely to occur during the process of data collection. Hence, a series of steps were followed over four stages to complete this research project. First, ethical approval from the University of Sydney Human Research Ethics Committee (HREC) (Appendix A) was obtained prior to the data collection process commencing. Then, permission to conduct the study was obtained from the Director of Academic Affairs at the University of Technology and Applied Sciences (UTAS), Oman (Appendix B). Once approval was granted to start this project, this letter was forwarded to the head of the English Language Centre (ELC) at the University of Technology and Applied Sciences (UTAS), Ibri campus to seek permission to commence the study and recruit participants. Subsequently, a presentation was conducted by the researcher to brief the head about the purpose of the study and the stages of data collection. Based on that, the Head of the English Language Centre (ELC) sent an email to all ELC staff with all the relevant attachments needed (Appendices C and D). Those who were interested in participating were contacted via email. Participant Information Statements (PIS) (Appendices E and F) were sent to all the participants so that they could be better informed about the purpose of the study and their roles; what they were required to do and the nature of their involvement. Additionally, all respondents were asked to sign a Participant Consent Form (PCF) prior to the study (Appendix G). Both forms highlighted the confidentiality and voluntary nature of the study and made clear to the participants that they were free to withdraw at any time without penalty or prejudice. The

confidentiality of the participants was maintained throughout the study by protecting their identities. All personally identifiable information was kept strictly confidential and coded by using titles such as “Participant A, Participant, B, ...” for the focus group and “Participant 01, Participant 02, ...” for Stages 2-4.

Since this thesis involved classroom observations, students were also informed about the study and their permission was also sought by sending the Participant Information Statement (PIS) (Appendix H) and Participant Consent Form (PCF) (Appendix I) to the potential classes through the Head of the English Language Centre to avoid issues of coercion or pressure to take part. All the data collected, associated records and documentation were securely stored on appropriate university licensed platforms to monitor and ensure research integrity. All soft copies of materials will continue to be kept in secured storage for five years once the study is finished. Furthermore, the neutrality of the researcher was maintained while writing the findings and conclusion. The researcher tried to be as objective as possible while creating the themes and designs of the study. The findings were then compared with other studies as well.

4.9 Summary

This chapter delivered a detailed description of the research design, sources of data collection and types of analyses to be conducted. Furthermore, it provides an overview of the research setting, participant recruitment, procedures, and ethical considerations. The study employed a mixed methods strategy through four stages providing valid evidence to support the measurement rubric and investigate the lecturers’ understanding and practice of formative assessment prior to and after receiving PD program. Having addressed the overall research process here, the following chapters present the outcomes and findings of the data collection and analysis.

Chapter 5: Development and Validation of a Measurement Rubric for Formative Assessment Practice and Associated Technologies

5.1 Introduction

This chapter presents the development of a measurement rubric for assessing the effectiveness of formative assessment practice informed by technologies in higher education. It describes the three-step process followed to construct the measurement rubric for this thesis: (1) define the construct to be measured; (2) identify the components that best comprise the construct; and (3) develop descriptions of performance for each increasing level of proficiency for each component. The chapter then describes the process used to build an evidential case to support the validity of the measurement rubric. Results of the validation process served to refine the draft measurement rubric and further strengthen its fitness for purpose. It also addresses Research Question 1: “What are the key components of effective formative assessment practice informed by technologies?”

5.2 Development of a Measurement Rubric

A draft measurement rubric was developed to assess the construct, which is formative assessment practice informed by technologies. The draft was based on research-derived pedagogical practices and technology design principles. It was refined considering Ramprasad’s (1983) three key processes in learning and teaching, the theories of formative assessment and views of Sadler (1989) and Black and Wiliam (1998), Wiliam and Thompson’s (2007) formative assessment model, Heritage’s (2010) cycle of formative assessment process, the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra and Koehler, 2006), and Vygotsky’s (1978) Zone of Proximal Development (ZPD) as well as the sociocultural constructivist view of learning.

The literature review in Chapter 2 explains the different types of rubrics, benefits and drawbacks of each, and the importance of developing a measurement rubric. As noted, rubrics can be differentiated on the basis of their composition and generalisability. Consequently, the measurement rubric developed for this thesis is an analytic, task-specific one. This type of rubric breaks down a specific task (technology-based formative assessment) into components and it provides detailed and specific feedback on lecturers' performance. That is, the ultimate purpose is to provide a measurement tool enabling lecturers to ascertain their understanding and practice of formative assessment, including how technologies inform their practice of it.

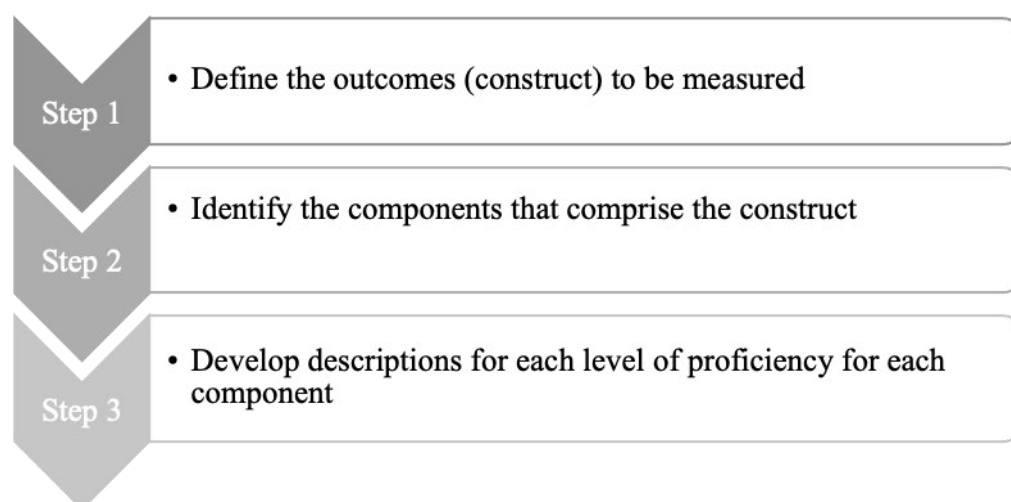
The measurement rubric ultimately will be used to self- and peer-evaluate the effectiveness of formative assessment informed by technologies. It can be used also to generate and provide evidence of lecturers' formative assessment practices that can then be located on the measurement rubric. Tognolini and Mowbray (2019) contended that this is the main difference between using rubrics to "measure outcomes" and using them to mark students' work. Again, referring to Tognolini and Mowbray (2019), the main difference is that in the latter case, the rubric remains constant and the tasks/situations vary. Rubrics used to measure outcomes are devised to capture the process of growth and progress on a particular outcome, and the manifestation of performance is captured in the submitted response to the tasks/situations that have been attempted. Such rubrics can show where performance is located relative to the outcome (or construct) and what is needed to reach the next highest level of proficiency in each component of the construct. Additionally, the process is applicable to all outcomes/constructs and all levels within the sector (Tognolini & Mowbray, 2019).

5.3 The Process of Developing a Measurement Rubric

The steps proposed by Tognolini and Mowbray (2019) were used to develop a draft of the measurement rubric for measuring the effectiveness of formative assessment practice informed by technologies. Tognolini and Mowbray (2019) identified five steps in developing a measurement rubric and then using it to measure the performance and to quantify this performance on a scale: (1) define the outcome/construct to be measured; (2) decide on the components that represent the construct; (3) develop descriptions of increasing levels of proficiency for each component; (4) develop situations (tasks) that will enable the provision of evidence of proficiency on each component; and (5) compare the evidence to the descriptions of levels of proficiency on each of the components, so that the evidence aligns with the description that best matches it. In a general sense, constructing a rubric in this format allows lecturers to not only measure their formative assessment practice but also to describe this practice and to make judgements based on results. Figure 5.1 illustrates the steps used to develop and construct the measurement rubric for this thesis.

Figure 5.1

Steps for Developing the Measurement Rubric Used in this Thesis



5.3.1 Step 1: Define the outcomes (construct) to be measured

The first step is to define the construct to be measured. In this thesis, the construct to be measured is the effectiveness of formative assessment informed by technologies. The starting point for the definition of the construct is formative assessment practice where the practice is to be informed by technologies. The definition of formative assessment to be used in this thesis was developed and discussed in Chapter 2. It is the:

ongoing process in which various tools and strategies, planned or unplanned, used during the learning process to provide lecturers and students with feedback so teaching and learning can be adjusted to close the gap between current learning and desired goals (Black & Wiliam, 1998a, 1998b; Black & Wiliam, 2009; CCSSO, 2018; Hattie & Timperley, 2007; Heritage et al., 2009; Ramaprasad, 1983; Sadler, 1989).

5.3.2 Step 2: Identify the components that comprise the construct

This step requires breaking down the construct “effectiveness of formative assessment informed by technologies” into smaller, more specific components. These components emerge from the proposed definition of formative assessment and the use of technology. Five components were derived from the definition and included in the initial draft of the measurement rubric: (1) eliciting evidence of student learning; (2) providing feedback; (3) using evidence to inform instruction; (4) creating collaborative culture of learning; and (5) using technology-based assessment. These components are direct attributes that reflect the integrated set of an ongoing process of formative assessment practice and associated technologies as previously illustrated in Figure 3.1. These components also provide evidence of lecturers’ practice of formative assessment informed by technologies as operationally defined.

The first component, eliciting evidence of student learning, focuses on the importance of using well-crafted tasks and activities that are appropriately aligned to the learning goals and designed to elicit evidence of student thinking which helps to understand where students currently are in their learning. The next component is related to the extent to which the lecturer provides feedback that advances learning. It addresses the distinct aspects of feedback that can be used to close or bridge the gap between current learning and intended learning goals. The third component uses evidence to inform instruction, and it focuses on lecturers' use of evidence collected to adjust or inform instruction across the lesson(s) as a whole. The fourth component helps to establish the classroom culture in which lecturers and students are partners in learning. It is about creating a collaborative culture that fosters lifelong learning, student thinking and autonomy and getting students to be learning resources for one another. The fifth component is specifically related to the use of technology tools as a support to inform the practice of formative assessment. Its aim is to boost students' engagement in the learning process. Then specific skills and knowledge that fall under each component were identified and labelled as "indicators" as shown in Figure 5.2.

Figure 5.2

Schematic Representation of the Measurement Rubric Used in this Thesis

FA Components	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Eliciting and interpreting evidence of student learning	Using tasks and activities to collect evidence of student understanding that are aligned with the learning goals	No attempt to engage the class with any activities	The lecturer uses tasks or activities that are not aligned to the learning goals	The lecturer uses tasks or activities that are partially aligned to the learning goals	The lecturer uses well-crafted tasks and activities that are mostly aligned to the learning goals	The lecturer uses a series of integrated, well-crafted tasks and activities that are appropriately aligned to the learning goals and will provide evidence of student progress toward those goals

These indicators help to identify typical traits of proficiency that signify a component being met or not. They define what determines an excellent performance (level of proficiency) for each formative assessment component. Generally, these indicators help assessors, or the rubric users to make sense of their expectations and encourage them to aspire to the highest level of proficiency.

5.3.3 Step 3: Develop descriptions for each level of proficiency for each component

The first decision related to the number and types of proficiency levels. Popham (1997) suggested that three to five levels of proficiency were appropriate, because he felt that rubrics were there to guide teachers not overwhelm them, i.e., “less is more”. The more levels there are, the harder it becomes to differentiate between the levels to precisely articulate the exact level of proficiency. There is no agreement in the literature about the number of levels or evaluative criteria needed for a rubric. Lane (2012) noted that the optimal number of performance levels (proficiency levels) for a rubric depends on how well each level can distinguish the different degrees of understanding and skill. In higher education, rubrics with four or five levels were commonly used and showed positive outcomes (Brookhart, 2018).

The measurement rubric in this case comprised five levels of proficiency (Level 0 to Level 4) that reflect the progression from no evidence of practice to expert practice. Five levels have been chosen to provide enough differentiation and guidance for lecturers without being too cumbersome or vague. These levels determine the degree of formative assessment practice which has been met, and they also give descriptions of how well or poor the practice of formative assessment is being devised and implemented. Each level provides a description of a particular aspect of formative assessment practice. The proficiency levels were identified and labelled in a way that was discrete enough to show the real differences using meaningful descriptors. Hence, each level was given a specific label to indicate a progression of practice

as well as to distinguish between each of the five levels: “0= not observed, 1= beginning, 2= developing, 3= progressing to 4= extending”. These labels were chosen to provide sufficient explanation about what proficiency looks like at each level on each component that describes the effectiveness of formative assessment practice informed by technologies. Then explicit descriptions of proficiency corresponding to each prescribed level of each component, which are call the “descriptors” were developed. These descriptions show how proficiency on each component can be measured and evaluated. These descriptions use language that shows growth from low to high and avoid evaluative judgments (Tognolini & Mowbray, 2019).

Using the measurement theory approach (Andrich & Marais, 2019; Bond & Fox, 2007; Bond et al., 2020), the proficiency level descriptors were developed to demonstrate growth in relation to each of components of the measurement rubric. These proficiency descriptors would be used to produce an image of the level of formative assessment practice needed to demonstrate that lecturers were at the various levels. They would capture evidence of lecturers’ effectiveness of formative assessment practice informed by technologies against the levels of proficiency. In other words, the progress across the levels of the measurement rubric is supported by evidence that the lecturer is performing at the level of proficiency described in the descriptor.

Table 5.1 documents a draft rubric that has emerged following the process outlined above. A content validation process was then conducted to ascertain the functionality of the draft measurement rubric to determine the extent to which it is fit for purpose. Developing a measurement rubric is a similar process to developing an educational or psychological test. It needs to be evaluated in terms of validity, reliability, and utility of test score interpretations (Messick, 1989b). The next section describes the validation process used to build the supportive argument that the measurement rubric is measuring the construct of effectiveness of formative assessment informed by technologies.

Table 5.1*A Draft Measurement Rubric for Assessing the Effectiveness of Formative Assessment Practice informed by Technologies in Higher Education*

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Eliciting and interpreting evidence of student learning	Using tasks and activities to collect evidence of student understanding that are aligned with the learning goals	No attempt to engage the class with any activities	The lecturer uses tasks or activities that are not aligned to the learning goals	The lecturer uses tasks or activities that are inaccurately aligned to the learning goals	The lecturer uses well-crafted tasks and activities that are mostly aligned to the learning goals	The lecturer uses a series of integrated, well-crafted tasks and activities that are appropriately aligned to the learning goals and will provide evidence of student progress toward those goals
	Pacing the questions during the lesson	Lecturer does not use questions effectively during instruction	The lecturer rarely paces questions	The lecturer generally paces the questions	The lecturer paces the questions appropriately	The lecturer paces the questions consistently and appropriately during the lesson. Including questions target higher order thinking
	Analysing and reviewing collecting evidence to identify student learning	No attempt	The lecturer does not review student work products during the lesson	The lecturer occasionally reviews student work products during the lesson or indicate when they will be reviewed	The lecturer reviews student work products during the lesson in a way that provides insight into most students' progress or indicates how work products will be reviewed later	The lecturer systematically reviews student work products during the lesson in a way that provides insight into most or all students' progress or clearly indicates how they will be reviewed and how the information will be used to inform instruction
Providing feedback that moves learning forward	Providing descriptive, corrective feedback and providing opportunities for peer feedback	No feedback provided	The lecturer provides feedback that is disconnected to the intended learning goals	The lecturer provides feedback that connected to the learning goals. Limited guidance on how to improve work	The lecturer provides feedback that connected to the learning goals and helpful guidance on how to improve work	The lecturer provides feedback that connected to the learning goals, provides opportunities to think about their own work and peers and provides helpful guidance on how to improve work
Using evidence to adjust instruction	Using information gained about student learning to inform instructional decisions.	No adjustments to instruction	The lecturer has no basis for adjusting instructional plans	The lecturer uses minimal adjustment during instruction	There is some evidence that the identified gaps and feedback are used to shape instructional decisions	There are multiple sources of evidence that indicate lecturer uses the identified gaps and feedback to shape instructional decisions and advance student learning
Creating collaborative culture of learning	Encouraging students to actively engage in learning through dialogue, discussions, and collaborative work with others.	No student-to-student or student-to-lecturer dialogue is observed	Student participation is limited to when the lecturer asks a question, and the lecturer does not capitalize on student responses or student questions to deepen learning	Minimal student-to student collaboration is evident	Student participation is encouraged, and the lecturer often capitalizes on student responses or student questions to deepen learning	Student-to-student collaboration is evident and spontaneous. Throughout the lesson, the lecturer and students demonstrate a growth mindset through their comments and questions
Using technology-based assessment	knowing about how to approach the task and able to work efficiently	No attempt to use technology to collect data	Most students are unclear about how to use the technology, and students require extensive repeated or revised instructions.	Many students are unclear about how to use the technology, and the lecturer takes some time to repeat or revise instructions	A few students are unclear about how to use the technology, and the lecturer takes minimal time to repeat or revise instructions.	Almost all students are clear about how to use the technology and are able to begin work efficiently
	Using technology for formative assessment purposes		The lecturer uses technology for different purposes	The lecturer occasionally uses technology to collect timely data	The lecturer uses technology to collect timely and efficient data	The lecturer uses technology to collect timely and efficient data engaging students in the learning process

5.4 Validation Process

The purpose of the content validation process is to maximise the collection of validity evidence from the measurement rubric by making sure that it is measuring only the construct effectiveness of formative assessment informed by technologies. Open-ended questions were asked during the focus group discussion to prompt discussion about different aspects of the draft measurement rubric. To critically reflect upon the draft measurement rubric and its core parts, the participants were first requested to consider the draft definition of formative assessment used in this thesis. Then, the following questions were asked:

- (1) What do you think about the components of formative assessment that have been provided in the draft measurement rubric? Do they capture the definition of formative assessment adequately? Are they sufficient?
- (2) Do you think that the application of technology has been described to show a developmental progression for that component of the draft measurement rubric?
- (3) Do the proficiency level descriptors map out an appropriate developmental path for each of the components?
- (4) Would you like to add any other information that has not been addressed in the provided draft measurement rubric?

The discussion focused on the application of the draft measurement rubric in the higher education context. The participants in the focus group discussion evaluated the content of the rubric and determined the extent to which they agreed or disagreed with the components used to capture the construct of formative assessment. This strategy is commonly used to evaluate content validity of various measures (Escobar-Pérez et al., 2008, as cited in de la Rosa Gómez et al., 2019). Each member of the focus group was given a copy of the draft measurement rubric and given time prior to the commencement of the discussion to study it. They assessed the robustness of the rubric and provided feedback about the rubric's

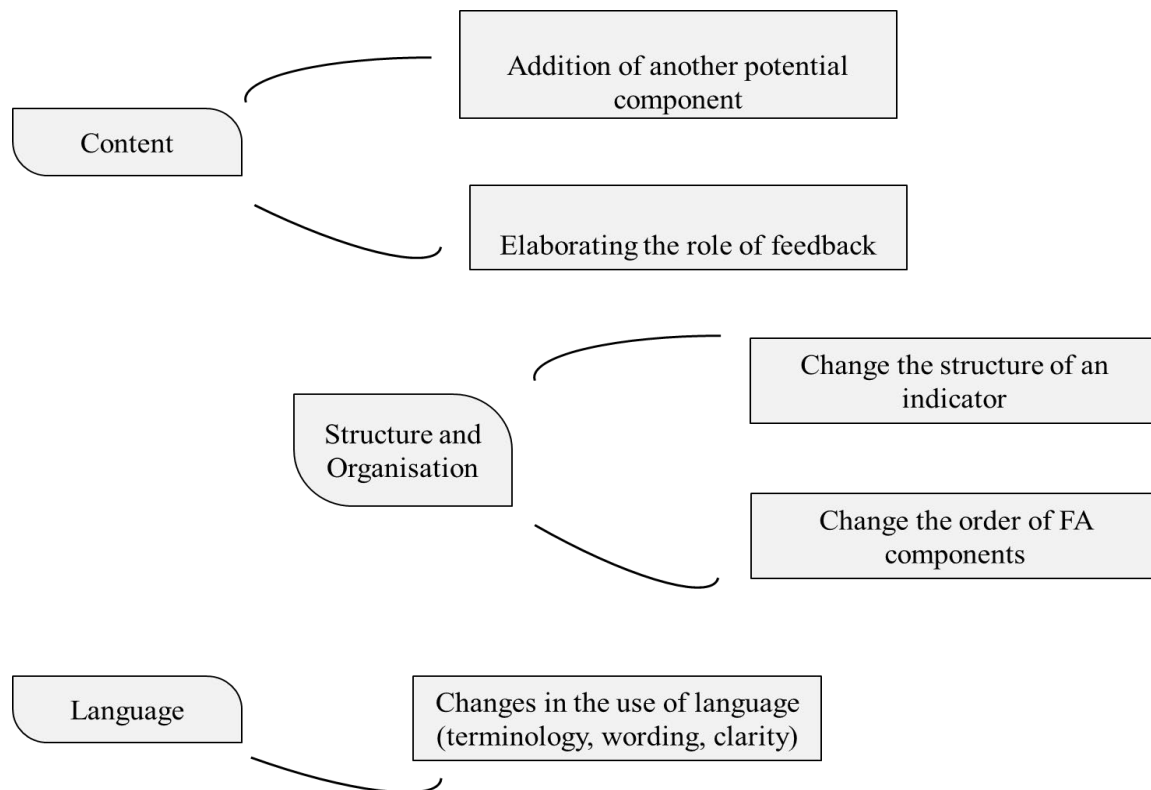
content, its main components, its practicality, and usability as well as the appropriateness of language used.

Once the discussion was transcribed, their responses were classified into three main themes that emerged from the coding process of the analysis of the focus group discussion. Within each theme, the researcher attempted to reflect on the experience of each participant. Following the main themes, some sub-themes and a reflection on what the researcher viewed to be significant are included in the following section.

5.5 Themes Emerging from the Focus Group Discussion

Considering the definition of the construct, all the participants agreed to fully accept the proposed definition of formative assessment as it was presented to them. The definition was perceived as allowing a common understanding of knowledge, skills and attitudes required to effectively implement and measure formative assessment practice. The discussion then moved on to consider the extent to which the draft measurement rubric accurately represented and adequately addressed the process of technology-based formative assessment practice with respect to the proposed definition.

The focus group suggested and recommended several changes that have been taken into consideration. Key themes that emerged fell under the following broad areas: (1) content, (2) structure and organisation, and (3) language. Figure 5.3 summarises the thematic categories that emerged from the focus group discussion. For the content, the focus group thought improvement in alignment could be made by including an additional component and elaborating the role and use of feedback. The focus group sought to improve the measurement rubric's structure and appropriateness by changing the structure of an indicator and changing the order of formative assessment components. For the use of language, the focus group closely looked at the clarity of the statements, terminology, and wording.

Figure 5.3*Focus Group Thematic Categories*

The first thematic category generated from the focus group discussion captured opinions and suggestions related to the content of the measurement rubric: (1) addition of another potential component and (2) elaborating the role and use of feedback.

5.5.1 Addition of Another Potential Component

In response to the questions “What do you think about the components of formative assessment that have been provided in the draft measurement rubric? Do they capture the definition of formative assessment adequately? Are they sufficient?” the focus group suggested adding an additional component to the measurement rubric to reflect the cycle of formative assessment. They argued that the measurement rubric should align with the proposed definition of formative assessment and its process, and that it should also include clear and distinct descriptions of proficiency to describe growth for each level of each

component. Participant F remarked that the draft of the measurement rubric covered the provision of feedback from both lecturers and students. She further sought clarification as to “whether it is student-student interaction or student-teacher interaction that was being considered. What about self-evaluation?” She remarked that the proposed definition highlighted the role of the students as well. In response to Participant F’s question, Participant B suggested adding “providing opportunities for students’ self-assessment as a new component”. Other participants supported this suggestion.

Therefore, “*Providing opportunities for students’ self-assessment*” has been added to the revised version of the measurement rubric as a new component and located as a third component. Since a new component was added to the revised version, there was also a need to develop an indicator that is more overtly aligned with student self-assessment and contained descriptions for each level of performance. Consequently, “Providing students with opportunities to think metacognitively about their own learning” was added to the measurement rubric as an indicator. As well, descriptions for each level of proficiency were constructed and added in the measurement rubric as shown below in Table 5.2.

Table 5.2

Addition of a New Component with its Indicator and Descriptions for Each Level of Proficiency

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Providing opportunities for students’ self-assessment	Providing	No opportunities	The lecturer rarely	The lecturer	The lecturer	The lecturer very
	students with	provided to	asks students to	occasionally asks	frequently asks	frequently asks
	opportunities to	engage students in	assess their own	students to assess	students to assess	students to assess
	think	self-assessment	learning and/or to	their own learning	their own learning	their own learning
	metacognitively		think	and/or to think	and/or to think	and/or to think
	about their own		metacognitively	metacognitively	metacognitively	metacognitively
	learning		to improve their	to improve their	to improve their	to improve their
			work	work	work	work

5.5.2 Elaborating the Role of Feedback

The participants in the focus group suggested that there was a need to elaborate the concept of feedback, considering that feedback is critical to the process of formative assessment. They suggested rephrasing the indicator “Providing descriptive, corrective feedback and providing opportunities for peer feedback” (Table 5.3) of the component “providing feedback that moves learning forward” to “Providing descriptive, corrective feedback, extending thinking during discussion, and providing opportunities for peer feedback”. According to them, the statements provided in the draft measurement rubric about the provision of feedback and its role in formative assessment were not precise enough.

Table 5.3

Proposed Feedback Indicator

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Providing feedback that move learning forward	Providing descriptive, corrective feedback and providing opportunities for peer feedback	No feedback provided	The lecturer provides feedback that is disconnected to the intended learning goals	The lecturer provides feedback that connected to the learning goals. Limited guidance on how to improve work	The lecturer provides feedback that connected to the learning goals and helpful guidance on how to improve work	The lecturer provides feedback that connected to the learning goals, provides opportunities to think about their own work and peers and provides helpful guidance on how to improve work

The indicator which related to the feedback in the draft of the measurement rubric implicitly classified the types of the feedback into “descriptive”, “corrective” and “peer feedback”. The focus group argued that the types of feedback cannot be limited to these. The participants stressed that the lecturers need to refocus their attention on feedback that is invested in students’ improved learning and thus meets the ultimate purpose of formative assessment. Students should be provided with feedback that helps to articulate their own

understanding of what characterises progress toward the intended learning goals. This developmental function of feedback should be clearly highlighted in the measurement rubric.

Based on the above discussion, it has been decided to rephrase the indicator of the 2nd component as “*providing descriptive, corrective feedback, extending thinking during discussion, and providing opportunities for peer feedback*”. Accordingly, the proficiency level descriptors have been modified to reference how to engage students in a discussion to deepen their thinking and understanding about their own work and peers. These suggestions shed light on the importance of providing ongoing feedback and subsequent engagement with students in a reciprocal discussion designed to deepen student understanding. Hattie and Clarke (2018) stated that feedback is not about how much feedback is given, but rather the quality of the feedback that is provided really matters. The most effective feedback focuses on providing information that “fills the gap between what is understood and what is aimed to be understood” (Hattie & Clarke, 2018, p. 3). It should provide information about “where to next” or “how to improve this work”. In other words, it should provide information to close the gap between the current learning and the intended learning goals. Table 5.4 summarises the changes in feedback indicator and the proficiency levels descriptors.

Table 5.4

Edited Feedback Indicator and its Related Proficiency Levels Descriptors

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Providing feedback that move learning forward	Providing descriptive, corrective feedback, extending thinking during discussion, and providing opportunities for peer feedback	No feedback provided	The lecturer provides feedback that is disconnected to the intended learning goals and the students are not engaged in a discussion	The lecturer occasionally provides feedback that is connected to the learning goals and there is a limited guidance on how to improve work. Occasional opportunities are provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers	The lecturer frequently provides feedback that connected to the learning goals and helpful guidance on how to improve work. Frequent opportunities are provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers	The lecturer very frequently provides feedback that connected to the learning goals and helpful guidance on how to improve work. Sufficient opportunities are provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers

Furthermore, Participant B suggested including the “wrap-up” component in the rubric. She illustrated that every session has formative assessment, and it is unique for every session. It begins at the eliciting stage and ends at the wrap-up stage. According to her, identifying gaps in student learning is clearly highlighted in the draft of the measurement rubric and closing the learning gap is supposed to be carried out in the wrap-up stage. Hence, she advised adding a “wrap-up component” with a solid indicator. However, it has been agreed in discussion that there was no need for inclusion of a “wrap-up” stage because the cycle of the formative assessment is already represented in the draft measurement rubric. The formative assessment cycle starts at identifying the shortfalls in students’ learning and this is clearly demonstrated in the first component and ends at resolving these gaps. Indeed, it ends at providing feedback to students and taking follow-up actions through adapting teaching and learning. The formative assessment cycle ends at adjusting current learning goals to meet students’ needs and then establishing new learning goals. It is basically an ongoing evaluation process included to ensure that gaps in student learning have been closed or bridged.

The second emergent thematic category includes changes in the structure and organisation of the draft measurement rubric. The suggestions that emerged from the discussion that characterised this theme were mainly focused on improving the structure of the measurement rubric and its appropriateness. The focus group participants suggested changing the structure of an indicator and changing the order of the components.

5.5.3 Change the Structure of an Indicator

The focus group generally believed that it would be easy for the users of the measurement rubric to comprehend the process of formative assessment and evaluate themselves or peers when the cycle of formative assessment is presented in a logical order. When interpreted rigidly, the measurement rubric should not only be an evaluative tool but also an instructional tool. Consequently, the measurement rubric should be appropriately

presented in a meaningful, sustainable, and scalable way. In light of this, the focus group recommended the following changes. The second indicator of the first component in the draft measurement rubric was “pacing the questions during the lesson” (Table 5.5). This indicator generated a debate among the focus group members about the term “pacing” and its relevance to asking questions during the lesson.

Table 5.5

Proposed Indicator in the Draft: Pacing the Questions During the Lesson

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Eliciting and interpreting evidence of student learning	Pacing the questions during the lesson	Lecturer does not use questions effectively during instruction	The lecturer rarely paces questions	The lecturer generally paces the questions	The lecturer paces the questions appropriately	The lecturer paces the questions consistently and appropriately during the lesson. Including questions target higher order thinking

According to the focus group, the term “pacing” is used to describe how a lesson generally flows or the speed at which lecturers move through a lesson. Participant B argued, “The lecturer rarely paces questions, generally paces the lesson. Pacing is subjective”. She added, “in level 4 of the same indicator, ‘including questions that target higher order thinking’, what if a teacher’s questions are not paced accurately but he or she covers HOTS [higher order thinking] questions? As I understand it, the pacing is the speed.”

“A person can be fast or slow but still be asking HOTS”. Another participant added, “We assume that students will answer these questions but what if we don’t give them enough time to answer? What about the progression and the quality of the questions and the level of students? It could happen that you ask questions, you get nothing, and you move on, so is that where the pacing applies?” Another remarked, “I think here it’s better to focus on asking

questions rather than pacing the lesson especially as we are focusing here in assessing students' formatively".

The discussion raised a significant question concerning the structure of this indicator. Indeed, asking questions can provide information about students' strengths and weaknesses to elicit evidence of their learning that accorded with the component "Eliciting and interpreting evidence of student learning". The consensus amongst the participants was that retaining "pacing" as an indicator for the first component may lead to a mismatch between the measurement rubric and the context. Consequently, the focus group agreed to change the structure of the second indicator which was "*pacing the questions during the lesson*" to "*asking questions that elicit evidence of student learning*" as shown in Table 5.6.

Table 5.6

Edited indicator from "pacing the questions during the lesson" into "asking questions that elicit evidence of student learning"

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Eliciting and interpreting evidence of student learning	Asking questions that elicit evidence of student learning	The lecturer does not ask questions or only asks questions that are related to classroom routines	The lecturer rarely asks questions designed to elicit evidence of student learning and provides inadequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning at a few points during the lesson and infrequently provides adequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning more frequently and often provides adequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning throughout the lesson and provides adequate wait time to answer

5.5.4 Change the Order of the Components

Another outcome from the focus group was a suggestion to change the order of the components so that it was easier for the rubric users to follow the cycle of the formative assessment process. The sequence of the formative assessment components presented in the draft measurement rubric has been changed because of the suggestion of the focus group. For instance, in the draft, the component "*Using evidence to adjust instruction*" was the 3rd

component. It has been shifted to be the 5th component in the revised measurement rubric.

The argument justifying this change was the view that there should be a logical sequence that reinforces the process of formative assessment and enables the lecturers or rubric users to know where to start, where to end, and when to move on to the next task or lesson.

One of the recommendations by Participant E was to locate “*using evidence to adjust instruction*” to be the last step or the step before the last “to have a natural progression of formative assessment process”. Participant C suggested, “I think using evidence to adjust instruction should be at the end of formative assessment cycle. To me, it makes more sense”. This component focuses on lecturers’ usage of collected evidence or student data to change the instruction as the lesson progresses. This evidence can come from, including but not limited to, tasks and activities, classroom questioning, student self-assessment, and student peer assessment. As such, the sources of evidence should be highlighted first in the measurement rubric followed by instructional adjustment. A logical flow from one formative assessment component to the other should be presented within the structure of the measurement rubric. Therefore, focus group participants suggested that the updated sequence of the components should be as follows:

1. Eliciting and interpreting evidence of student learning.
2. Providing feedback that moves learning forward.
3. Providing opportunities for self-assessment.
4. Creating a collaborative culture of learning.
5. Using evidence to adjust instruction.
6. Using technology-based assessment.

Moreover, the focus group suggested that the descriptions of performance for the last component “*Using technology-based assessment*” (Table 5.7) should first emphasise that

lecturers should have the knowledge and skills to use technology effectively for formative assessment purposes before administering the tasks and providing instructions to students.

Table 5.7

Proposed FA Component: “Using technology-based assessment” in the Draft Measurement Rubric

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Using technology-based assessment	Knowing how to approach the task and being able to work efficiently	No attempt to use technology to collect data	Most students are unclear about how to use the technology, and students require extensive repeated or revised instructions	Many students are unclear about how to use the technology, and the lecturer takes minimal time to repeat or revise instructions	A few students are unclear about how to use the technology, and the lecturer takes some time to repeat or revise instructions	Almost all students are clear about how to use the technology and are able to begin work efficiently
	Using technology for formative assessment purposes		The lecturer uses technology for different purposes	The lecturer occasionally uses technology to collect timely data	The lecturer uses technology to collect timely and efficient data	The lecturer uses technology to collect timely and efficient data engaging students in the learning process

Based on the above discussion and to support the argument for the validity of the measurement rubric, the description related to the lecturers’ knowledge on using technology for formative assessment purposes has been moved to the first row and then the description related to knowing about how to approach the task in the second row of the description levels of performance for the component “*using technology-based assessment*”. In turn, the order of the indicators “*using the technology for formative assessment purposes*” and “*knowing about how to approach the task and able to work efficiently*” has been changed as illustrated in Table 5.8 below.

Table 5.8*Edited FA Component: “Using technology-based assessment” and its Indicator*

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Using technology-based assessment	Using technology for formative assessment purposes	No attempt to use technology to collect data	The lecturer uses technology for different purposes	The lecturer occasionally uses technology to collect timely data	The lecturer frequently uses technology to collect timely and efficient data	The lecturer uses technology to collect timely and efficient data engaging students in the learning process
	Knowing how to approach the task and being able to work efficiently		Most students are unable to use the technology and require extensive repeated or revised instructions	Many students are unable to use the technology, and the lecturer takes minimal time to repeat or revise instructions	A few students are unable to use the technology, and the lecturer takes some time is to repeat or revise instructions data	Almost all students are able to use the technology and can work efficiently

5.5.5 Change the Wording

The last theme that emerged from the focus group discussion was the use of language. This theme focused on the clarity of the statements, terminology, and wording.

There is no doubt that the language used in the measurement rubric needs to be clear so that it can be interpreted accurately and consistently. The clarity of the language used in the measurement rubric was a crucial issue for the participants. They were cautious about the syntax and wording of the language used in the draft of the measurement rubric. They were conscious of the appropriate use of vocabulary, clarity of statements, and the transition from one performance level to the next. They considered that using descriptive and comparative language in the measurement rubric would help to minimise any confusion that may occur during the application of the measurement rubric and would maximise consistent interpretations related to the application and use of the measurement rubric. The following

suggestions (Table 5.9) were considered and implemented in the revised version of the measurement rubric.

Table 5.9

Use of Language and the Revised Statements in the Measurement Rubric

No.	Statements used in the draft measurement rubric	The revised statements
1.	The lecturer uses tasks or activities that are inaccurately aligned to the learning goals	The lecturer uses tasks or activities that are partially aligned to the learning goals
2.	The lecturer does not review student work products during the lesson	The lecturer rarely reviews student work products during the lesson
3.	The lecturer has no basis for adjusting instructional plans	The lecturer seldom adjusts instruction
4.	Students are unclear about how to use the technology , and students require extensive repeated or revised instructions	Students are unable to use technology and require extensive repeated or revised instructions

The focus group perceived the necessity to rephrase certain proficiency level descriptors used in the draft measurement rubric to ensure progress flows from one level to another. For example, the statement used as description for Level 1, “The lecturer uses tasks and activities that are not aligned to the learning goals” conveyed the same meaning as the statements used to describe level 2, “The lecturer uses tasks or activities that are inaccurately aligned to the learning goals”. Participant B commented, “This sounds redundant to me because, ‘not aligned’ means that the tasks and activities are not connected so how is not aligned different from inaccurately aligned?” Consequently, it has been suggested to replace the term “*inaccurately aligned*” with “*partially aligned*”.

In the same vein, the focus group found that it is hard to make a distinction between level 0 description “no attempt” and level “does not review” in the statement “The lecturer does not review student work products during the lesson to review student work products during the lesson”. Similarly, using the statement “no adjustments to instruction” followed by

“the lecturer seldom adjusts instruction”. These phrases created overlap as they almost have the same meaning. The gradual transition from one level to another should be expressed by using a parallel structure and a language that shows growth. For instance, starting the descriptions with no attempt to seldom to occasionally would be more appropriate. Furthermore, “limited to” should come before “minimal” and not vice versa as in the descriptions of Level 1 and 2 in “creating collaborative culture of learning”. Hence, it has been decided to replace “does not review” with “rarely reviews” and “the lecturer has no basis for adjusting instructional plans” with “the lecturer seldom adjusts instruction”.

Moreover, the focus group agreed to swap between the statements of the component “creating collaborative culture of learning” so that “student participation is limited to when the teacher asks a question” will be a description for level 1 and “minimal student-to student collaboration is evident” will be a description for level 2.

Another important change in terms of the clarity of statements emerged in the descriptions of the last component in the measurement rubric draft. The statement “most students are unclear about how to use the technology, and students require extensive repeated or revised instructions” was queried. According to the focus group, this statement could convey the meaning that it was the lecturer’s fault for not being able to explain to the students how to approach the task using the technology. They believed this would be unfair to the lecturers because this may happen for several reasons, for instance, if students have an unstable internet connection. So it is not the lecturer’s fault in this case. Participant B argued, “...how can I say my students are unclear about my instructions if they are unable to join because of internet connection problems”. Participant A added, “We don’t know what’s going on the other side, by saying students are unclear about the instruction, we put the whole burden on the lecturer”. Therefore, the focus group thought that this statement “most students are unclear about how to use the technology, and students require extensive repeated or

revised instructions”, needs to be rephrased for the purpose of fairness and to be applicable for online classes too.

The focus group also suggested to replace the term “unclear” with “using technology inefficiently” or “not engaged” or “unable to use the technology”. They unanimously believed that such terms could be fairer to both lecturers and students. Thus, the focus group decided to rephrase it with “students are unable to use technology and require extensive repeated or revised instructions”. In this case, it means that students are unable to join or engage in an activity and they need more guided instructions.

In summary, the focus group revised the proposed draft of the measurement rubric to produce a measurement rubric that they believe is better understood and should lead to more consistent interpretations and be a better representation of the essence of technology-based formative practice. In other words, it is more valid than the previous draft measurement rubric. Generally, the focus group members reacted positively to the draft measurement rubric and thought it would be an important contribution to the field of educational assessment in higher education. A high degree of consensus among the focus group members showed that the measurement rubric has the potential to be a useful resource for lecturers to evaluate themselves and their peers. The process of review conducted during the focus group has, according to the participants, produced a more valid and fair measurement rubric.

5.6 Summary

A draft of the measurement rubric for assessing the effectiveness of formative assessment practice informed by technologies was developed during the preliminarily phase of the study. The steps for developing the draft of the measurement rubric were: (1) define the outcomes (construct) to be measure, (2) identify the components that comprise the construct, and (3) develop descriptions for each level of proficiency for each component.

The focus group discussion was conducted to provide content validity evidence supporting the draft measurement rubric for its use as a measure of the effectiveness of formative assessment practice informed by technologies in higher education. Based on the data generated during the focus group discussion, further revisions were made to the measurement rubric to enhance the confidence in the inferences made by the focus group.

The final measurement rubric (Table 5.10) is now going to be used in this thesis to provide pre-and post-professional development implementation measures of how effective lecturers have been in formative assessment practice informed by technologies. In addition, it serves to inform the professional development program which was used as a treatment in this thesis to help the participants to implement formative assessment and associated technologies effectively and consistently as part of their classroom duties.

It is hoped that this measurement rubric will further equip lecturers with the means to identify their strengths and weaknesses in formative assessment and associated technologies. Given that the formative assessment components used in the measurement rubric reflect the ongoing process of effective formative assessment practice that are widely recognised in the literature (Heritage, 2010), this measurement rubric could be applied in other contexts in higher education settings.

The next chapters present the results of the data collected from three consecutive and interrelated research stages (Stages 2-4) aimed at: (1) determining the participants' current understanding and practice of formative assessment and associated technologies; and (2) examining the extent to which participants develop their understanding and practice of formative assessment and associated technologies after receiving a professional development program targeting technology-based formative assessment.

Table 5.10

The Measurement Rubric for Assessing the Effectiveness of Formative Assessment Practice informed by Technologies after Consideration by Focus Group

FA Component	Indicator	Level				
		0 (Not observed)	1 (Beginning)	2 (Developing)	3 (Progressing)	4 (Extending)
Eliciting and interpreting evidence of student learning	Using tasks and activities to collect evidence of student understanding that are aligned with the learning goals	No attempt to engage the class with any activities	The lecturer uses tasks or activities that are not aligned to the learning goals	The lecturer uses tasks or activities that are partially aligned to the learning goals	The lecturer uses well-crafted tasks and activities that are mostly aligned to the learning goals	The lecturer uses a series of integrated, well-crafted tasks and activities that are appropriately aligned to the learning goals and will provide evidence of student progress toward those goals
	Asking questions that elicit evidence of student learning	The lecturer does not ask questions or only asks questions that are related to classroom routines	The lecturer rarely asks questions designed to elicit evidence of student learning and provides inadequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning at a few points during the lesson and infrequently provides adequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning more frequently and often provides adequate wait time to answer	The lecturer asks questions designed to elicit evidence of student learning throughout the lesson and provides adequate wait time to answer
	Analysing and reviewing collected evidence to identify student learning	No attempt to review student work products during the lesson	The lecturer rarely reviews student work products during the lesson	The lecturer occasionally reviews student work products during the lesson or indicate when they will be reviewed	The lecturer frequently reviews student work products during the lesson in a way that provides insight into most students' progress or indicates how work products will be reviewed later	The lecturer systematically reviews student work products during the lesson in a way that provides insight into most or all students' progress or clearly indicates how they will be reviewed and how the information will be used to inform instruction
Providing feedback that moves learning forward	Providing descriptive, corrective feedback, extending thinking during discussion,	No feedback provided	The lecturer provides feedback that is disconnected to the intended learning goals and the students are not engaged in a discussion.	The lecturer occasionally provides feedback that is connected to the learning goals and there is a limited guidance on how to improve work. Occasional	The lecturer frequently provides feedback that connected to the learning goals and helpful guidance on how to improve work. Frequent opportunities are	The lecturer very frequently provides feedback that connected to the learning goals and helpful guidance on how to improve work.

	and providing opportunities for peer feedback			opportunities are provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers	provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers	Sufficient opportunities are provided to engage students in a discussion to deepen their thinking and understanding about their own work and peers
Providing opportunities for students' self-assessment	Providing students with opportunities to think metacognitively about their learning	No opportunities provided to engage students in self-assessment	The lecturer rarely asks students to assess their own learning and/or to think metacognitively to improve their work	The lecturer occasionally asks students to assess their own learning and/or to think metacognitively to improve their work	The lecturer frequently asks students to assess their own learning and/or to think metacognitively to improve their work	The lecturer very frequently asks students to assess their own learning and/or to think metacognitively to improve their work
Creating collaborative culture of learning	Encouraging students to actively engage in learning through dialogue, discussions, and collaborative work with others	No student-to-student or student-to-lecturer dialogue is observed	Minimal student-to-student collaboration is evident	Student participation is limited to when the lecturer asks a question, and the lecturer does not capitalize on student responses or student questions to deepen learning	Student participation is encouraged, and the lecturer often capitalizes on student responses or student questions to deepen learning	Student-to-student collaboration is evident and spontaneous. Throughout the lesson, the lecturer and students demonstrate a growth mindset through their comments and questions
Using evidence to adjust instruction	Using information gained about student learning to inform instructional decisions	No adjustments to instruction	The lecturer seldom adjusts instruction	The lecturer uses minimal adjustment during instruction	There is some evidence that the identified gaps and feedback are used to shape instructional decisions	There are multiple sources of evidence that indicate lecturer uses the identified gaps and feedback to shape instructional decisions and advance student learning
Using technology-based assessment	Using technology for formative assessment purposes	No attempt to use technology to collect data	The lecturer uses technology for different purposes	The lecturer occasionally uses technology to collect timely data	The lecturer frequently uses technology to collect timely and efficient data	The lecturer uses technology to collect timely and efficient data engaging students in the learning process
	Knowing how to approach the task and being able to work efficiently		Most students are unable to use the technology and require extensive repeated or revised instructions	Many students are unable to use the technology, and the lecturer takes minimal time to repeat or revise instructions	A few students are unable to use the technology, and the lecturer takes some time to repeat or revise instructions	Almost all students are able to use the technology and can work efficiently

Chapter 6: Participants' Current Understanding and Practice of Formative Assessment and Associated Technologies

6.1 Introduction

This chapter reports on the findings of the initial interview and classroom observations conducted prior to receiving a professional development (PD) program as part of the study. A semi-structured interview was conducted with 12 lecturers from the English Language Centre (ELC), at the University of Technology and Applied Sciences (UTAS-Ibri) in Oman to determine how much formative assessment is currently being carried out, and how the technology is used to support this practice. The data generated from the interviews were used to answer the Research Question 2: “How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?”

The chapter then describes how to determine the effectiveness of formative assessment practice informed by technologies prior to the PD phase. Classroom observations were used to locate lecturers on the measurement rubric. Observations of four classes were conducted during scheduled classroom visits with the time of observation ranging from 60 to 95 minutes. The findings from classroom observations were used to answer the Research Question 3: “How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?”

6.2 Findings of Initial Interview Data

The following questions were asked during the interview conducted at the beginning of the study:

1. How would you define formative assessment?
2. In your opinion, what are the purposes of formative assessment?
3. How are learning goals communicated to students?

4. How do you usually elicit and interpret evidence of student learning?
5. When and how do you provide feedback to your students?
6. Do you adjust your instruction based on feedback from formative assessment? If yes, how?
7. Do you use technology as a tool for formative assessment practice? If yes, how? If no, why not?

The emerging themes from the initial interview data were classified into two categories. Themes that related to the participants' perceptions (including developing a good understanding of formative assessment and knowing its purposes) and themes that related to the participants' interpretation of formative assessment pedagogical practices and associated technologies (including understanding of formative assessment as a process and its classroom application). The thematic categories are summarised in Table 6.1

Table 6.1

Inductively Developed Thematic Categories from the Initial Interview

Codes	Themes
1. Defining formative assessment	Knowledge and Understanding
2. Knowing the purposes of FA	
1. Communicating learning goals	FA pedagogical practices and associated technologies
2. Eliciting evidence of student learning	
3. Interpreting the evidence	
4. Providing feedback	
5. Instructional adjustments	
6. The use of technology	

6.2.1 Knowledge and Understanding

The first emergent theme obtained from the initial interview related to the participants' knowledge and understanding. This theme included two subcategories: defining

formative assessment and knowing the purpose of formative assessment that were aligned with the first and second initial interview questions: “How would you define formative assessment?” and “In your opinion, what is the purpose of formative assessment?”

6.2.1.1 Defining Formative Assessment. Participants’ initial understanding of formative assessment was sought through the first question of the interview: “How would you define formative assessment?” The definition of formative assessment has been developed earlier in Chapter 2 of this thesis and is repeated here.

Ongoing process in which various tools and strategies, planned or unplanned, used during the learning process to provide lecturers and students with feedback so teaching and learning can be adjusted to close the gap between current learning and desired goals. (Black & Wiliam, 1998a, 1998b; Black & Wiliam, 2009; CCSSO, 2018; Hattie & Timperley, 2007; Heritage et al., 2009; Ramaprasad, 1983; Sadler 1989).

When asked to define formative assessment, the participants’ responses varied from knowing very little to having a good understanding of the meaning of formative assessment. During the interview, Participant 03 stated that he had no idea what formative assessment was. His response to the question was:

I really don’t have any idea about it. Are we talking about the exams, quizzes? Sorry I think I have no idea. I’m not quite sure about that maybe it’s too technical a term, I think. (Participant 03, Interview 1)

He lacked knowledge about formative assessment. To some extent, Participant 08 was also unsure how to define formative assessment. She was able to partially define formative assessment, but she was too was hesitant while she was speaking.

She stated:

I'm not that kind of expert in this field. As far as I know it's when the teacher and students take part in the learning process where they kind of, you know, take part in the instruction and in the process of feedback, put them together and then have the teachers follow up with the students so that they help them in the learning process something like that I hope I'm correct. (Participant 08, Interview 1)

The participants aligned quizzes, assignments, and mid-term examinations as formative assessment or according to their perspective, "continuous assessment". For instance, Participant 01 said, "I would define it as continuous assessments like quizzes used by teachers and students throughout the semester to assess or evaluate students' performance". Similarly, Participant 12 summarised the definition of formative assessment as, "Formative assessment is something which we call continuous assessment in our university". In fact, continuous assessment as it is used at the University of Technology and Applied Sciences (UTAS-Ibri) is merely frequent summative assessment. Their focus is on awarding students' marks and grades.

Participant 06 described formative assessment as "whenever we test or try to assess the level of the students throughout the semester using like exams and quizzes". Participant 09 defined formative assessment as "assessment practices that we administered to students in order to get immediate feedback about their performance in the form of quizzes or the form of diagnostics tests". Likewise, Participant 10 considered both quizzes and final exams as formative assessment. His response was, "It is ongoing assessment, conducting quizzes, mid-terms, and final exams. So, it is the ongoing assessment process from the beginning of the semester until the end of the semester". Meanwhile, Participants 02, 07 and 11 were able to partially define formative assessment. Participant 02 defined formative assessment as:

Assessments that monitor students' comprehension levels and their understanding, not at the end, but in the middle of the lesson. While they are forming a particular idea of

a lesson while they are in the process of learning not at the end of the lesson. There are checks at every stage. Otherwise, the teacher cannot proceed with the lesson if proper comprehension does not happen in the student. (Participant 02, Interview 1)

This lecturer was able to reveal several key features of formative assessment. For instance, it was evident from her definition that she understood that it is conducted during the learning process. It is an ongoing process in that “there are checks at every stage”. Participant 07 also identified some key features from the definition used in this thesis. She defined formative assessment as “an assessment that is done to find out where your students stand in a level or whatever you have taught them”. It is evident that Participant 07 knew the purpose of formative assessment which is to determine students’ mastery of a subject up to a particular point in time. She also added that it is “addressing those weak areas which students are facing so formative assessment to me is something which helps to find out the student weaknesses in problems and helps teacher to design the lesson keeping in view those problems and solving those problems”. Indeed, formative assessment is about identifying students’ strengths and weaknesses. Participant 11 viewed formative assessment as:

The micro moments that we assess students in the classroom. It can be like a small 5- or 10-minute quiz it could be a project, it could be a worksheet, or it could be something as simple as having an oral discussion in the classroom and listening for things like grammar and vocabulary and pronunciation. (Participant 11, Interview 1)

Participant 11 was able to define formative assessment as a day-to-day task that provides a range of formal and informal assessment strategies.

Two participants were able to define formative assessment in a manner that was like the definition used in this thesis. Participant 04 asserted:

I would define formative assessment as something that I do while teaching in a session, plus in a term or a semester and my formative assessment guides me how to

change my plan or how I should change my methodology while I'm teaching.

(Participant 04, Interview 1)

She was able to address most of the key features of formative assessment's definition. She argued that it occurs throughout the teaching role and is designed to provide evidence about her methods and students' learning accordingly. In a similar way, Participant 05 shed light on some of the key features of formative assessment, like feedback and its role in this assessment's practice. According to her, formative assessment is "a kind of assessment that we would normally give to students to assess how they understand the lesson". She added, "I think formative assessment plays a very important part because during a lesson using formative assessment means that we get proper feedback which means that we can review and clarify misconceptions".

The above findings highlighted the degree of confusion between different kinds of assessments: summative, formative, and diagnostic. The findings revealed there is no agreed understanding of the term 'formative assessment' amongst participants. Here the participants' responses could be categorised into 3 main types: (1) not able to define formative assessment, (2) can partially define formative assessment, and (3) can closely define formative assessment.

6.2.1.2 Knowing the Purposes of Formative Assessment. The 2nd interview question: "In your opinion, what are the purposes of formative assessment?" provided an opportunity for the participants to freely express themselves as to the purpose of formative assessment even though they could not clearly define it.

Six participants indicated that the purpose of formative assessment is to check students' understanding and monitor their progress. For instance, Participant 02 said that the purpose of formative assessment is to "check students' understanding on a regular basis". Participant 05 also indicated one purpose of formative assessment which is to "give the

teachers an idea on how well the students understand the lessons, it is a way of finding weaknesses”. Participant 06 said it is “to check students’ progress”. Participant 09 stated that the purpose was the same but in a slightly different way: “to get immediate evidence, not to wait until the end of the semester or until the end of the academic year to know the academic performance of the student”. She added, “to monitor the students on a continuous basis”. Participant 12 went further and remarked, “We can find who is a low achiever in a classroom or who is really doing well”.

Other participants were able to elaborate the purposes of formative assessment and go beyond its significance as a means of monitoring students’ progress. For instance, Participant 01 focused on the role of formative assessment in assessing the lecturers on adjusting and planning instruction based on the students’ needs. He commented: “The purpose of formative assessment is to consider new ways of teaching to track students’ performance”. Participant 03 stated that the purpose is to “tailor classroom activities according to the students’ needs”. In contrast, Participant 04 neglected the significance of formative assessment on the students, and she focused on the lecturers themselves: “It’s mostly for me; not my students”. She illustrated this as follows by stating that “formative assessment guides me on how far I should proceed with the concept before I move on teaching something else”.

Participant 10 was able to shed light on its significance for both students and lecturers. This person specified the purposes of formative assessment as “checking student understanding” and “modifying our ways of teaching, assessments, and methods that we use”. From a different perspective, Participant 07 was able to identify at least three purposes of formative assessment. She stated that, “Formative assessment is for both students and teachers”. She clarified this further by adding, “it gives a reflection to a teacher about his/her own teaching” and “gives ideas to individual students about where they stand, how far they are from their targets and how much they have achieved and how much they need to

achieve”. She was able to identify the purpose of formative assessment on guiding students to take control of their own learning. Participant 08 also shared a similar response when she said, “allowing students to know how to reach learning outcomes”.

One person, Participant 11, believed that formative assessment offered a comprehensive purpose for both students and lecturers. According to her, “the purpose is to not only understand where the students are at this moment but also you know the individual students as well as the collective class. She added, “It’s being able to march them forward to the end goal or the end objectives of the semester, so that I can appropriately plan, scaffold and march them in the direction so that we meet that end goal”. She elaborated:

understand where the struggles are, where are the issues that may or may not be part of the end result but that we need to really pay attention to throughout the semester so that we can get them to a level of proficiency and competency and confidence in order to help them grow as language learners. (Participant 11, Interview 1)

Her response to this question was consistent with what Sadler (1989) wrote about the fundamental purpose of formative assessment, which is to identify and close the gap between students’ current learning status and the intended learning goal. In short, the purpose of formative assessment is to “promote further learning” (Heritage, 2007).

Most of the participants looked at the purposes of the formative assessment from one viewpoint. They thought that the purpose of formative assessment is merely for the students, and they did not shed light on its direct significance for the lecturers themselves. This shows a great variation in their understanding of formative assessment and its purposes.

6.2.2 Formative Assessment Pedagogical Practices and Associated Technologies

The second theme related to the implementation of the formative assessment pedagogical practices and associated technologies. This theme was divided into the following subcategories: (1) communicating learning goals, (2) eliciting evidence of student learning,

(3) interpreting the evidence, (4) providing feedback to students, (5) making instructional adjustments, and (6) using technology. This theme emerged from the responses to the initial interview questions (3-7) which focused on determining the lecturers' current knowledge on how well they implemented each component used to capture what formative assessment means.

6.2.2.1 Communicating Learning Goals. The lecturers should ask themselves: firstly, what are the learning goals that they should have identified and communicated to the students; secondly, what is the students' current level of learning; and thirdly, what can they do to bridge the gap between students' current understanding and the desired learning goals. As advised by Wiliam (2018), the answers to these three queries should be taken into consideration when implementing formative assessment:

- (1) Where are my students going?
- (2) Where are my students right now?
- (3) What do I need to do to get my students there?

This makes explicit that an important part of implementing formative assessment is that lecturers must determine what learning goals must be shared and communicated with students.

The programs and curricula used at the University of Technology and Applied Sciences (UTAS-Ibri), Oman, are the same for the other campuses of UTAS in terms of the design of programs, learning goals and outcomes. Each program comprises several courses and for each one, there is a delivery plan with objectives and learning outcomes. It means that the course delivery plan, learning outcomes and learning goals are prepared by the institution and disseminated to the lecturers. In this case, the lecturers do not have to prepare any overarching plans. What matters is how lecturers communicate the learning goals and the objectives to their students. When the participants responded to Question 3 of the initial

interview, “How are the learning goals communicated to students?”, 11 participants out of 12 responded that they uploaded learning goals online (via MS Teams if they are conducting an online class or Moodle for face-to-face classes). It was evident from the answers that they uploaded the course plan along with the learning goals, objectives and learning outcomes at the beginning of the semester and handed them to the students with minimal discussion.

While most participants reported that they uploaded the plan online, Participant 01 noted, “I don’t usually describe the lesson goals or lesson objectives for students”. Participant 01 was teaching face-to-face classes. He said that it could be complicated for students to understand the written format of the course plan “but it is clear for me as I’m working on achieving the learning outcomes”.

Besides sharing it online, two participants indicated that sharing the written format of the course plan with learning goals at the beginning of the semester is not enough. There is a need to focus the students’ attention on what they are going to learn and why. Participant 05 commented that “some students do not really check it when it is uploaded online”. They tended to explain verbally the course plan and its attachments (i.e., learning outcomes, objectives, learning goals). Participant 11 said, “I show them the information on the screen in written format and then either read it aloud or I call on different students to have them read the objectives”. Participant 05 restructured the learning goals into simpler language that is appropriate for her students’ level of proficiency by “using words that would fit instruction and students’ level”.

In summary, some participants at UTAS-Ibri showed that they relied on the plan that is administered by the institution’s perspective and shared it online with their students and again, discussion was minimal. A few of them went further and structured the learning goals in student-friendly language.

6.2.2.2 Eliciting Evidence of Student Learning. Once the learning goals and success criteria have been articulated, the lecturer moves to the next step of the formative assessment. That is planning the formative assessment strategies that would generate the evidence needed to provide feedback for learning. In turn, this feedback shapes the lecturers' actions in helping their students close the gap between their current learning status and learning goals.

A central practice of formative assessment is to use tasks and activities to elicit evidence of student learning that are appropriately aligned with the learning goals and then provide evidence of student progress. These tasks and activities range from planned to spontaneous formative assessments that allow both the lecturer and the student to access information about how learning is progressing (Heritage, 2010). The initial interview data showed that the participants had little understanding about how to elicit and interpret evidence of student learning. In response to Question 4 of the initial interview "How do you usually elicit and interpret evidence of student learning?", four participants responded that they use formal tests and quizzes to gather evidence of learning. For example, Participant 12 said that "I give them a short test that gives me understanding of their progression". Likewise, Participant 10 remarked, "I usually give them assignments". Similarly, Participant 06 responded by saying that "through quizzes, e-portfolios, and assignments", while Participant 08 indicated that she used "quizzes, questionnaire and midterm exams".

Two participants considered both formative and summative assessments as strategies for eliciting evidence. Participant 01 stated that it was done "by using different tools like observation, group discussion, assignments and exams". Added to this, "the punctuality about submitting assignments and homework is important as well". Participant 09 also mentioned "worksheets, activities, quizzes and tests". Meanwhile three participants claimed that they relied on one single strategy to gather evidence of how student learning is evolving. Participant 04 replied, "I highly rely on concept checking questions", Participant 08

responded that “e-portfolios are basically used as evidence of students’ progress” and Participant 11’s “favourite way of doing this is through oral classroom discussion”. Three participants replied that they use several methods to assess students’ understanding of their learning. For instance, according to Participant 02, “there is no single way of eliciting evidence. I can tell that there are many ways and their use depends on the course and the nature of the lesson”.

Based on the above responses, there is a mix of formative and summative assessments and that most participants relied on a type of assessment that is typically used to measure students’ competency at the end of unit or course (e.g., mid-term and final examinations). They relied on assessments that are more geared towards the formal end of structured assessments.

6.2.2.3 Interpreting the Evidence. Almost all participants indicated that they could use planned and unplanned formative assessments to build evidence of student learning and then interpret it accordingly. Question 4 of the initial interview was, “How do you usually elicit and interpret evidence of student learning?” Participant 02 responded by providing an example as follows: “a student is able to use a particular language item then I would consider it as yes, he or she understood”. By doing so, she can tell that her students are on the right track to learning well. However, she did not mention the pedagogical approach she would take if her students did not grasp the concept being taught. In contrast, Participant 05 asserted that “if there are some misunderstood concepts then they would need to be verified at the time”. She added that sometimes she needs to gather other forms of evidence like class activities, probing questions and utilising homework tasks to further investigate whether they really understood the taught concepts or not. Indeed, using more than one form of formative assessment (as well as summative assessments) and carefully unpacking students’ data can help the lecturer to get a clear image of students’ progress toward learning goals. Some

participants illustrated that they relied on one strategy to elicit and interpret the evidence. For instance, Participant 06 stated that “in terms of writing skills, I ask them to write a draft and then I give them feedback. I may or may not ask for a second draft. It depends on their progress”.

Participant 08 identified the same procedure. She provided feedback for the first draft of her students’ writing and then her students wrote a second draft based on her feedback. She said, “I give feedback and then the students consider this feedback before they rewrite a second draft and so on”. The second draft can reveal where her students are in terms of their progress. Participant 11 mentioned that she frequently uses oral classroom discussion as a primary way of eliciting evidence of student learning. She interprets this evidence through monitoring her students’ oral development: “If they can do it orally then they can take those skills and apply them to their writing and reading skills”. She added, “It is connected to their confidence. If students become confident speakers, they will be confident in the language used”. This strategy was considered to be an effective way to identify gaps between where students are in their learning and where they are headed. Participant 12 indicated that she uses both planned and spontaneous assessment as a strategy to generate evidence of student understanding: “those assessments give me understanding about whether I should end this lesson here or they need more time to understand”. Depending on her students’ responses, she spells out the consequences for the pedagogy. When lecturers analyse the evidence, they look for the gaps between where students are currently in their learning and where they are headed.

The above responses showed that virtually every participant can gather evidence of student learning whether they use planned or spontaneous (on-the-fly) assessments. However, the responses of some participants revealed that the process of formative assessment stops at the point of eliciting evidence of student learning. It is imperative to note that eliciting

evidence to merely identify the gap in learning is not enough. They must understand why it exists and then support their students to close or bridge that gap.

6.2.2.4 Providing Feedback. Question 5 in the initial interview focused on how and when lecturers provide feedback to their students. In response to the question “When and how do you provide feedback to your students?”, all participants replied that they provide immediate feedback. Informants were relatively unanimous in their responses that the nature of the task can shape the duration and the way the feedback is given. In this regard, Participant 01 contended that “it depends on the task but in all cases I provide feedback directly after the task”. Participant 03 said, “I provide feedback usually after every activity” and Participant 06 said, “I’m teaching writing skills, so I give feedback immediately after each draft”.

The participants then described the way that they provided feedback to their students. Their responses listed a variety of feedback mechanisms such as written, oral, class, individual and peer-directed. Three participants reported that they usually provide oral feedback. For example, Participant 04 remarked, “I use conception checking questions then I keep eliciting [responses from students] until we reach the right answer” and Participant 03 answered, “I make sure that the next day I will tell them what they missed in their writing, what they need to improve and how they’re supposed to address such challenges”. Two participants indicated that they prefer to use peer feedback as a strategy to provide feedback. Participant 02 clarified that “feedback will come from their peers because I feel that sometimes it is more effective than teachers’ feedback”. Participant 06 applied two strategies and one of them is peer feedback: “I ask each student to revise another student’s work and then they can discuss together and share with me the corrections or feedback”. Four participants believed in the value of providing individualised descriptive feedback. Participant 11 suggested that “for writing skills, they submit me written documents, I will

review it and give each student notes and feedback. I will then send it back to them”. She added, “I will make notes to myself of the more common problems, and I will have a presentation for them on the global problems that I’ve seen”.

Lecturers’ observations of students constitute a valuable source of formative assessment that most participants did not consider. Participant 11 also described a strategy of providing feedback that none of the others mentioned. According to her, “At least once during semester in my writing class I have a one-on-one interview for 5 to 10 minutes to discuss issues in writing it works like a mini lesson for each individual student”. Another three interviewees mentioned that they relied on using a combination of both written and oral feedback. Besides the written feedback, they provide oral feedback which can vary based on its type and function. For instance, Participant 07 categorised her feedback as “formal and informal”. She explained that she writes her comments in the assigned area in the “Class Notebook” in Microsoft Teams. In the written comments she highlighted her students’ weaknesses: “I will highlight the mistakes and I will give them the feedback that tells where they stand so they can read the comments for themselves and improve themselves”. She opined, “informal feedback can be through the body language and verbal feedback can be done during class discussions”. Participant 07 responded by indicating that feedback directed students toward the desired learning goals and success criteria. Indeed, students should be provided with a clear path of how subjects or topics should be mastered. It is also worth mentioning that some participants viewed feedback as merely providing the right and wrong answers. Several participants explained that they are using “MyELT” which is a web-based learning management system, one designed by National Geographic Learning as part of the “Pathways” textbooks. They clarified that they used “MyELT” as a tool to assess students’ performance and provide feedback to finalise the tasks and then move on to the next task.

6.2.2.5 Instructional Adjustments. During the initial interview, the participants were asked “Do you adjust your instruction based on feedback from formative assessment? If yes, how?” Participant 03 stated that, “I tailor my lessons according to their [students] needs”. He added, “If I figure out that my first activity is a failure or the students did not get it, I cannot move to the next phase”. Participant 04 explained that she may adjust her instruction during the same session. She explained, “I plan something, and I feel like my students are stuck so I just change my lesson there and I invest more time in the concept and reflect on it later”. Five participants asserted that they provide extra practice. Participant 02 clarified, “if I find my students are very slow, I need to re-think and shape the activity in order to make them confident”. She added, “I do re-look at my instruction, so that it is easily understood by the students and the objectives become achievable, otherwise there is no point in just blindly sticking to the planned instruction”. Similarly, Participant 05 indicated that her teaching adjustment is predominantly determined by students’ performance. She pointed out, “If more than 50% of the class is left behind, then that means I will be the one to make the adjustment. But, if let us say only a certain percent of the class, like 5%, I still would think that I would keep up with whatever that I am doing and make those students adjust instead”. She proceeded, “if I would be the one to make certain adjustments then I would have to get down there in order for them to be lifted so I would change maybe two more student-oriented tasks; more student-oriented activities”. Likewise, Participant 06 argued that the main purpose of collecting feedback is to adjust classroom instruction accordingly. She responded to the question as follows:

Yes, absolutely, otherwise what’s the point if we collect feedback and then we don’t give students what they need. So absolutely if I notice that they are weak in grammar for example I provide more grammar exercises. (Participant 06, Interview 1)

The participants' responses showed that if the status of student learning reveals a weakness in a specific area, lecturers direct their attention to providing students with the needed knowledge or skill through giving them more practice.

Four participants indicated that they use both re-teaching and provide extra practice to adjust their instruction. For instance, Participant 07 said, "most of the time you get feedback from your students and then you give more practice or reteach again". Participant 09 remarked that her instructional adjustments vary from one class to the next. She illustrated that she modifies her teaching methodology and teaching materials based on her students' performance and their needs. She stated, "I have to tailor my lesson; to customise it". She proceeded, "if there are slow learners in a particular class then I change my methodology and the activities to meet the needs of the students". Participant 11 specifically mentioned an example of her recent grammar class when her students were struggling with not being able to toggle between present and past tense. She added, "I'm always tweaking my lessons, I have to adjust my lessons so that we are always incorporating the present and past tense".

The findings revealed that all the participants adjust their instruction when the students' data showed that they did not grasp a concept. The main ways in which the teachers modify their instruction included re-teaching and providing extra practice. Moreover, several participants revealed that they modified their instruction for the entire class, not for individuals or smaller groups of students.

6.2.2.6 The use of technology. Participants' responses regarding the last initial interview question "Do you use technology as a tool for formative assessment practice? If yes, how? If no, why not?" confirmed that, because of the impact of COVID-19, technology in their teaching and learning was basically mandatory.

Participant 05 verified this as follows:

I'm teaching a level that is utilising online resources and the available technologies to deliver classes, to do what is needed and therefore I don't have any choice but to use technology for assessment. (Participant 05, Interview 1)

Participant 09 also affirmed this was the case: "We rely on technology when it comes to teaching students during critical situations like the pandemic and at the same time face-to-face classes".

More specifically, they utilised the available resources to conduct tasks and activities as well as provide feedback using MS Teams and Moodle. Both systems were online platforms used at the University of Technology and Applied Sciences (UTAS), Oman to keep education going during the COVID-19 pandemic. Participant 10 clarified, "I use Class Notebook in MS Teams. Students submit their written assignments, so I correct their mistakes and give them feedback". Class Notebook is "a digital notebook for the whole class to store text, images, handwritten notes, attachments, links, voice, video, and more" (Microsoft, 2022). It is a private avenue of communication between lecturers and each student. To reiterate, those participants who were teaching online had to use Microsoft Teams to conduct their classes, whereas those who were teaching on campus did not have to use Microsoft Teams. They had the choice of alternatively using "Moodle" and/or "MyELT" to conduct supplementary materials. "MyELT" was used exclusively by those who were teaching a foundation program only.

The participants' responses revealed that their knowledge of using technology plays an important role in effectively integrating it into formative assessment. For instance, Participant 03 stated, "I have always integrated technology into my teaching, even in my previous universities". He added that "it's easier and more convenient to send feedback". Conversely, Participant 01 admitted, "I personally face difficulties in providing and discussing feedback with individuals using technology. I'm not familiar with the

technology”. He also added that “the Internet service is weak for many students”. He frustratingly concluded, “I tried to use technology throughout the previous semesters but I’m not happy about technology”.

Moreover, selecting the right technological tools can make formative assessment more effective and meaningful. Participant 04 stated, “I have been extensively using an app called ClassPoint. I ask questions, students write their answers, and everybody can see their answers”. She continued, “I use it either at the beginning of a class to check their prior knowledge or at the end of the class to guide my next lesson”. Likewise, Participant 11 responded as follows:

I use Google forms and chat box. In the chat box I give them all kinds of opportunities to send me information. It’s about having these one-on-one conversations and large group discussions. I can continuously identify their communication breakdowns and then what I need to do to help them adjust those problems or those communications breakdowns. (Participant 11, Interview 1)

The interviewees’ responses highlighted that they managed to use various tools including the student response system (SRS) tools and other resources at Microsoft (MS) Teams to create a real-time feedback loop. In this way lecturers could instantly adjust their instruction and bridge the gap in student learning. In turn, students were able to receive immediate feedback on their understanding of the content. However, some participants acknowledged that they used these tools and applications merely for the sake of enjoyment. Participant 12 said:

Students enjoy *Quizlet* and *Mentimeter*. It is a change for them when I feel that they are not enjoying the current presentation. I add some exercises, quizzes using these apps just to make the lesson more interesting. (Participant 12, Interview 1)

Similarly, another participant stated:

I use some apps to make teaching a little bit more interesting or to break that monotony, but not as inevitable part of teaching system. In fact, given a chance, I would love to avoid these tools. (Participant 02, Interview 1)

It could be assumed that the participants' responses gave insights as to what circumstances might promote the use of technology to mediate formative assessment as well as the constraints that can emerge and undermine their ability to do their job.

6.3 Findings of Initial Classroom Observation Data

As stated earlier, the classroom observations shed light on the participants' formative assessment practice and in turn helped to answer Research Question 3: "How well do lecturers in a higher education institution in Oman apply and practice formative assessment enhanced by technology?" This section unpacks the formative assessment pedagogical practices observed in relation to the key components of effective formative assessment practice presented in the measurement rubric.

Evidence from classroom observations was collected and then compared with the descriptions of the different levels of proficiency in the measurement rubric. This evidence was subsequently used to locate them at the most appropriate level. Shown here is the location of the participants' ratings on the measurement rubric.

As shown in Table 6.2, the results from the observations of four classes revealed that most participants scored at either Beginning (Level 1) or Developing (Level 2) Levels.

Table 6.2

Initial Classroom Observations Summary

FA Component	P04	P05	P10	P11
	Level of Proficiency (rating)/4			
Eliciting and interpreting evidence of student learning	3	1	1	3

Providing feedback that moves learning forward	2	2	2	2
Providing opportunities for self-assessment	3	2	0	2
Creating collaborative culture of learning	3	1	1	1
Using evidence to adjust instruction	3	1	1	2
Using technology-based assessment	4	2	0	0
Total/24	18	9	5	10
Mean Score/4	3	1.5	0.8	1.6

The observational data revealed that Participant 04 was located at the highest levels on the measurement rubric compared to the others. She was able to assess her students formatively to gauge what they had learned and/or retained from the previous lessons. She was able to use different strategies to ensure learning was properly acquired. Participant 10, on the other hand, performed relatively poorly as he employed the conventional method of teaching. He presented information using a PowerPoint presentation and his students were passively receiving the knowledge being presented. For the most part, he was lecturing the students instead of providing the students with the opportunity to take responsibility for their own learning. He responded to his students with either a Yes/No or correct/incorrect response. The sub-section below provides an interpretation of the evidence collected during classroom observations of the participants.

6.3.1 Eliciting and Interpreting Evidence of Student Learning

Two out of four participants were located at Level 3 (Progressing) on the measurement rubric for the first formative assessment component “Eliciting and interpreting evidence of student learning”. The other two were located at Level 1 (Beginning). The

participants located at Level 3 (Progressing) were frequently observed using tasks and activities that were well-crafted and mostly aligned to the learning goals and the lesson objectives. They also analysed and reviewed the collected evidence to identify student learning. For instance, Participant 04 first communicated the objectives of the lesson to her students that specified the path being taken. She used questioning strategies (Concept Checking questions; CCQs) which elicited evidence of student learning and helped to make sure they were on the right track. She also provided an adequate waiting time for them to answer her questions and then reviewed and discussed their answers. To some extent, she provided insights into her students' progress and indicated how their written work will be reviewed later. Similarly, Participant 11 used various questioning strategies that were infused into the lesson and mostly aligned with the objectives. Questions were specifically designed to elicit evidence of students' learning and their responses were also frequently reviewed during the lesson. She was also rated as Level 3 (Progressing) in this component.

Although Participant 05 provided students with two different tasks that were embedded in "ClassNotebook" in MS Teams, she did not review their answers in real time. She was located at Level 1 (Beginning) on the measurement rubric for this FA component. She only accepted responses from those who raised their hands without paying attention to those who were left behind. In other words, there were minimal attempts to analyse and review students' responses to identify their learning habits. She addressed a few of the responses and then carried on with the lesson. After they did the activity, she said, "If you are sure about what you know, we can proceed to another activity".

Participant 10 was also rated at Level 1 (Beginning) in eliciting and interpreting evidence of student learning component. He commenced by revising the previous lesson and followed by introducing the objectives of the day's lesson. He then used Concept Checking Questions (CCQs) to check students' understanding only at a few points after the material

had been taught. The questions were directed to the whole class and those who seemed to be active students, were the only ones who attempted to answer questions. He also did not allow sufficient waiting time for his students to give answers. There was no clear evidence that the lecturer was able to gauge his students appropriately or knew their performance level with reference to the objectives that were the focus of the day's session.

6.3.2 Providing Feedback That Moves Learning Forward

For the second component “Providing feedback that moves learning forward”, all the participants were located at Level 2 (Developing). The feedback provided by the observed lecturers was limited and is categorised into two types: (1) corrective feedback where the participants stated whether the student response was correct or not, (2) positive feedback in which the student received a positive evaluative comment such as, “excellent” and “very good”. For example, Participant 05 was conducting a “filling in blanks activity with the appropriate verb tense”. She read the sentence and the class responded. She then acknowledged whether their answers were correct or not and she also provided positive comments for correct answers.

Participant 11 followed the same approach in terms of feedback. It was a grammar lesson and the students were answering an activity from the textbook. She provided corrective feedback along with some positive comments. The description of Level 2 performance in the measurement rubric indicated that “there is a limited guidance on how to improve work” and that was exactly the kind of feedback provided by lecturers to their students. No cognitive feedback was evident in the forms of comments, suggestions, or guidance to the students on how to improve their work or deepen their thinking and understanding about their own work and that of their peers, as is illustrated in the measurement rubric. The participants also missed pivotal moments that could have served to provide structured opportunities for peer feedback. For example, tasks in Participants' 04 and

10 writing classes could have been utilised to allow students to give and receive feedback on each other's written work which in turn could have allowed them to deepen their understanding. Indeed, it is not about providing feedback but the quality of feedback that is most important.

6.3.3 Providing Opportunities for Students' Self-assessment

There were rare occasions in which the participants provided opportunities for the students to assess their own learning. Students need to be aware of not only their own level of learning, but also to be able to think metacognitively about their own learning and this can be done through self-assessment. As illustrated in the measurement rubric, the lecturer should frequently ask students to assess their own learning and/or think metacognitively. In this regard, Participant 10 scored Level 0 (Not observed) practice since no opportunities at all were provided for self-assessment during that class. Both Participants 05 and 11 were rated as Level 2 (Developing) and they were observed occasionally asking students to assess their own learning through the activities assigned in "ClassNotebook" in MS Teams.

Participant 04 was placed at Level 3 (Progressing). Her classroom episode illustrates how she utilised some class activities as opportunities for students' self-assessment. Although there were few opportunities for self-assessment, she used different strategies to ensure that her students could not only do it but also receive peer assessment. She was able to activate students as learning resources for one another. For instance, she engaged them in group work where they worked together and supported each other. However, she could occasionally identify approaches to engage students in an experience where they could evaluate their own learning and set targets to achieve the assigned learning goals. This, in turn, potentially cultivated their metacognitive learning skills so that they became independent learners and developed a good sense of self-efficacy.

Overall, it was noted that students' self- and peer-assessment were less prominent among all the observed classrooms. Wiliam (2011) argued that students' self- and peer-assessment are crucial for developing their understanding, encouraging and motivating them to think about their learning and to develop metacognitive skills.

6.3.4 Classroom Culture

The observational data showed that the lecturers oversaw the learning process. The environment of the observed classroom indicated that either there was minimal student-to-student, student-to-teacher dialogue or students' participation were limited to when the lecturer asked the questions and invited the students to answer.

To successfully achieve the ultimate purposes of formative assessment practice and deepen students' learning, a classroom culture should be established in which both lecturers and students are partners in the learning process. The agency of both lecturers and students are important determinants in the successful application of formative assessment. Both should be jointly active and responsible for the learning process which can be achieved through collaboration between lecturers and students. Yet, most participants were observed to be "spoon-feeding" their students. They were not able to generate a positive impact on classroom culture. They all were located at the lower level (Level 1). For instance, Participants 05 and 11 were located at Level 1(Beginning) in this component. They both failed to create a collaborative culture of learning between teacher and students. Few students were actively participating in discussions whereas others passively absorbed the information. It could be considered as a missed opportunity for students to have a voice and to build their confidence and be assertive.

Participant 04, on the other hand, made some attempts to create an environment in which she encouraged students' participation by reflecting on their work. She productively played the role of the facilitator at certain points during that lesson. For example, when she

conducted the self-assessment task, she tried to get them to formulate their own thoughts. She supported students' learning and that was observed through her role as a facilitator, while they did the activity. Consequently, she was located at the Level 3 (Progressing) on the measurement rubric.

6.3.5 Instructional Adjustments

The researcher focused on the participants' use of evidence collected from various sources to adjust instruction throughout the lesson. This indicated that the identified gaps in student learning and feedback were used to shape instructional decisions with variation between the participants in their level of performance. For instance, Participant 11 was located at the Level 2 (Developing) on this component. There was minimal adjustment noticed during that class. For example, she adjusted her teaching when a student mispronounced a word containing the letter "p" and pronounced it as "b". It seemed that her students often mispronounced these two letters and that was why she considered this as evidence of student learning to inform instruction; she tended to reteach the concept and provide extra activities.

Participant 04 was rated as Level 3 (Progressing). She used L1 (language 1; native language) which is the students' mother tongue (Arabic) as a means of scaffolding. Throughout the lesson, as instructional adaptations based on the evidence of the student learning, she provided examples, used synonyms, and asked for the meaning of unknown lexical items in Arabic. It became evident that she used students' data about their current learning to inform her next instructional decisions. More specifically her decisions were evidence-based.

Conversely, both Participant 05 and Participant 10 were located at Level 1 (Beginning). They were seldom observed modifying their teaching methods, although there were opportunities where that could have been integrated. Participant 05 was observed only

once changing her lesson style when she saw that the students were having difficulty working out what they were supposed to do. She took the opportunity on this occasion to make the instructions clearer using simplified English. She noticed that her students were struggling, so she set out to stimulate their understanding. In other words, she conveyed the requirements of her task in a way that accommodated students' needs. Although some participants used a variety of sources both formal and informal to collect evidence of student current learning, they were unsuccessful to make use of the collected evidence to make instructional decisions about the next step.

6.3.6 The Use of Technology

During the first set of classroom observations, the participants used Microsoft Teams (MS Teams) as a platform to conduct classes. Some of the observed lecturers utilised the facilities and sources that are available in MS Teams to conduct different assessment activities, whereas others used it as a key pedagogical tool. Participants 10 and 11 used MS Teams merely for delivering the course content. They both scored Level 0 because there were no attempts at all to use technology to collect evidence of students' current learning status. Technology was not used for formative assessment purposes.

Participant 04 was the only one who was located at Level 4 (Extending) on the "using technology-based assessment" component of the measurement rubric. She effectively used "ClassPoint" which is an app that is integrated into MS PowerPoint, to conduct an "Exit Ticket" toward the end of the lesson. The students answered the questions using their devices. She in turn was able to see all the responses and feedback in real time on the screen. She then highlighted certain misconceptions based on their responses. Using such a powerful interactive classroom tool allowed her to not only collect instant responses, but also clarify misconceptions and/or adjust instruction when necessary.

6.4 Post-Observation Feedback Discussion #1

A meeting was conducted with all 4 participants, individually, who took part in the observation process within 24 to 48 hours of the observations. The discussion allowed ample opportunities for them to provide additional details that were not directly observed or explicitly articulated during the lesson. What is more, the participants can compare their own evaluation with the researcher's evaluation. The intention was to collect further evidence to increase the inferred outcomes obtained by observation.

The meeting commenced with the lecturer being provided with a copy of the classroom observation protocol form that contained the observation ratings and post-observation feedback form (Appendix N). The researcher then allowed the lecturer to ask or comment on any aspect of the researcher's evaluation of the lesson summarised in the participants' ratings on the measurement rubric. In this way, the location of the lecturer on each of the formative assessment components was discussed with each participant. For example, Participant 05 commented on her performance regarding the feedback and self-assessment opportunities provided to the students. According to her:

I know that I didn't focus on providing detailed or individual feedback in the lesson, but I usually make use of homework to further investigate whether or not they really understood. (P05, Post-Observation Discussion #1)

The researcher also asked each participant to identify any deviations in the lesson plan that could have influenced the rating, and asked them to indicate whether they felt that they had achieved the targeted goals or not and how they arrived at that decision. For instance, Participant 10 indicated that he sometimes delayed the feedback until the next session he had with the class, especially when the next session for the class was a continuation of the previous session.

The researcher also informed the participants that they might take into consideration the value of creating a classroom environment that encourages student collaboration. The students should be engaged productively during the lesson. The researcher also suggested including a variety of strategies, like pair-work and group-work (cooperative groups) into their lessons. The meeting with each lecturer was concluded by asking them to make a note of their strategies and ways of interpreting students' data and providing feedback for the next classes to be shared during the professional development program.

6.5 The Content of the Professional Development Program

Based on the initial findings that revealed participants' limited understanding and practice of formative assessment, a 4-day professional development (PD) program was tailored to their needs. Table 6.3 shows the content of each session.

Table 6.3

The Content of the Professional Development Program

Session	Content
Session 1: Where are we going?	• Definition of FA • Formative Assessment vs Summative Assessment • Benefits of FA • Key components of FA • The process of FA • Learning goals and criteria for success
Session 2: Where are we now? Identifying gaps in student learning	• Eliciting and interpreting evidence of student learning • Instructional strategies
Session 3: How to get there?	• Closing the gap: Feedback & Instructional adjustments

Session 4: Putting it into practice	• Integration of technology • Using the developed measurement rubric to self-evaluate your FA practice
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Note. FA indicates Formative Assessment

Session 1 as shown in Table 8.3 explored what formative assessment means, its key components, benefits, and the process involved. Session 2 focused on how to elicit and interpret evidence of student learning using various instructional strategies that the participants failed to mention during the interview or even during the classroom practice such as observation, self- and peer-assessment and classroom engagement. Since the participants cited ineffective ways of feedback provision and instructional adjustments, Session 3 was designed to address how to close the gap between students' current learning and the desired learning outcomes through providing effective feedback.

Session 4 explored how to integrate technology as a tool to support formative assessment practice. It showed them examples of how to use SRS for formative assessment purposes using "ClassPoint" and "Quizizz" as well as exploring the features of MS Teams for formative assessment practice. Session 4 also involved showing the participants how to use the measurement rubric and provided guidelines regarding how to self-evaluate their formative assessment practice and that of their peers. A detailed agenda of each session is described in Appendix P.

6.6 Summary

This chapter explored the findings of the interviews and classroom observations that were conducted at the beginning of the study, prior to the professional development (PD) program, for lecturers at The University of Technology and Applied Sciences (UTAS-Ibri), Oman. This exploration contributed to answering Research Questions 2 and 3.

Overall, data from the initial interview showed that the participants have a limited understanding of formative assessment. They regarded continuous assessments such as tests,

quizzes, graded assignments, and homework as the only forms of formative assessment. They put more emphasis on mid-term and final examinations where feedback was limited, if non-existent. Such practice, by itself, cannot provide a complete picture of what students know and can do. Another major finding was that they made no reference to formative assessment as an ongoing process that supports teaching and learning.

Besides the participants' inconsistent use or understanding of formative assessment, two other key findings emerged from the classroom observations. The first revealed that the lecturers' implementation of formative assessment practice reflected their perceptions and beliefs of formative assessment. It showed a direct alignment between classroom practice and their pre-conceived perceptions of formative assessment. Their understanding influences their decision-making and implementation of formative assessment practice. In other words, inadequate knowledge leads to poorer rating levels.

The findings also identified certain issues to be discussed during the professional development (PD) program. For example, results showed that there was a need to have the participants consider ways to collect more targeted evidence, elicit and interpret that evidence, provide effective feedback that leads to better student learning and take nuanced decisions to adjust instruction tasks and strategies. It was clear that the participants needed to focus more on using technology in an effective way, particularly SRS to consolidate their formative assessment practice. The next chapter explores the observable changes in the participants' understanding and practice of formative assessment after receiving the PD program.

Chapter 7: Observable Changes in the Understanding and Practice of Formative Assessment and Associated Technologies

7.1 Introduction

This chapter focuses on analysing data to determine any observable changes in the participants' understanding and practice of formative assessment and associated technologies after the professional development (PD) phase. It reveals the findings of the interviews and classroom observations conducted toward the end of the study. It describes how the PD program can influence changes in understanding and practice of technology-based formative assessment. The classroom observations data were analysed to develop narrative descriptions about the participants' implementation of formative assessment and the use of technology to enhance their practice based on the measurement rubric. Observations of eight classes were conducted after the post-professional development (PD) phase, Stage 4 of the study, to observe any changes in lecturers' formative assessment practice informed by technologies. The same procedures that were used to collect the classroom observations of the first set were repeated.

The interview data were analysed to determine if there were any changes in the participants' understanding of formative assessment and associated technologies. A thorough analysis of the data resulted in three inductively developed themes: (1) Gain in knowledge and shift in beliefs, (2) Developed understanding of FA pedagogical practices and its key components, and (3) Existing supports and barriers to the implementation of formative assessment practice and associated technologies. This chapter provides the basis of further exploration into Research Question 4: "To what extent do lecturers who have undertaken a Professional Development program targeting technology-based formative assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?"

7.2 Findings of Classroom Observation Data #2

Classroom observations were conducted toward the end of the study (Stage 4) to measure any changes in the participants' practice after receiving a professional development (PD) program. A wealth of teaching approaches and a very large range of strategies were used by the participants, but the researcher maintained a focus on formative assessment practice and associated technologies using the classroom protocol that applied the measurement rubric (Appendix M). A professional judgement was used with the help of the measurement rubric to find out whether the teaching practice was used to support formative assessment or not. Table 7.1 below shows the results of the classroom observations conducted during Stage 4.

Table 7.1

Classroom Observations #2 Summary

FA Component	Participants							
	P02	P04	P05	P06	P07	P10	P11	P12
	Level of Proficiency (rating)/4							
Eliciting and interpreting evidence of student learning	4	4	3	4	4	1	4	3
Providing feedback that moves learning forward	2	3	3	4	2	2	3	3
Providing opportunities for self-assessment	3	4	3	4	4	0	3	3
Creating collaborative culture of learning	3	4	3	3	4	1	3	4
Using evidence to adjust instruction	3	3	3	4	2	1	3	4
Using technology-based assessment	3	4	3	4	4	0	3	3

Total /24	18	22	18	23	20	5	19	20
Mean Score/4	3	3.6	3	3.8	3.3	0.8	3.1	3.3

Overall, most of the participants showed an improvement in their use of formative assessment and associated technologies. For instance, Participant 05 revealed improved practice in all components against the use of SRS tools in her language classes. She was convinced after attending the PD and made use of SRS tools such as “Kahoot!” and “Quizizz” to stimulate her classroom instruction and thus support formative assessment practice.

7.2.1 Eliciting and Interpreting Evidence of Student Learning

All the observed participants clearly articulated and communicated the objectives of the lessons and showed the connections as they proceeded in the lesson. This was a good indicator of their understanding of the value of sharing and communicating the learning goals. It could be that the participants identified and shared well-crafted learning goals and criteria for success, but these were not necessarily complemented in the lessons with appropriate tasks and/or activities. From a practise point of view, it was very important to make sure that the selected tasks and activities used by lecturers were aligned to the lesson’s goals and conducted to collect sufficient and relevant evidence of student learning.

As for eliciting the evidence of student learning, the participants were frequently observed collecting evidence of student learning at both the beginning and end of the lesson. Throughout the lesson, they kept questioning students’ understanding to identify anything missing in students’ learning. Participants 02, 04, 06, 07 and 11 were located at Level 4 (Extending) in this component. The observational data showed that they effectively used a series of well-crafted tasks and activities directly aligned with the intended learning and students’ needs. For instance, the lesson’s objectives of Participant 4 were: “(1) students will be able to identify the elements of an application letter” and (2) “apply the elements to write

an application letter”. She provided two main tasks to achieve these objectives. For the first task, she displayed a written paragraph “advertisement” and asked her students two questions related to the advertisement: (1) “What is the workability skill?” and (2) “What are some examples given by the writer?” When her students successfully answered the questions, she moved to the main task which was “Choose one or two workability skills from the advertisement and write your own paragraph. You have 12 minutes. Write 4-5 sentences”. Through her pre-task questions, she was able to elicit “where the student is located on the developmental continuum right now” and this allowed her to move to the main writing task. She had also provided them brief and simple directions for the task. In turn, the students were quickly engaged in the task and approached it without any confusion. An adequate waiting time was also given which allowed them to submit their responses. She was able to get their responses in real time using “Class Notebook” via MS Teams. However, she did not review their writing work during that lesson, and she justified that during the post-observation feedback discussion as she was planning to do that at the beginning of the next lesson.

Similarly, Participant 02 commenced with unpacking the lesson’s objectives with her students. It was a “listening and speaking” lesson and she elicited students’ understanding and interpreted the evidence through a series of tasks and activities. Pre-teaching vocabulary was conducted at the beginning to establish the listening task and to ensure that the vocabulary was not going to detract from the validity of the listening assessment. This was followed by a group speaking activity in which she was able to hear how her students were progressing. It allowed her to identify what they knew and their needs that required some further work done on their speaking skills. She also conducted “post-speaking activity” in which she allowed each individual student to answer the questions that were included in the exit activity using “ClassPoint”, an SRS tool. Participant 06 examined students’ current level of understanding through a preparatory activity using “Quizizz”, another SRS tool.

Participant 11 used questioning strategies to elicit and interpret evidence of students' understanding. The main aim of her lesson was to design a project questionnaire, so prior to designing it, she showed them a sample of a questionnaire and kept asking them Concept Checking Questions (CCQs) like: "What do you think about this question?"; "What about the order of these questions?"; "Are these open-ended or closed questions?"; "What about the wording?", etc. Although they were relatively simple queries, students' responses revealed their level of understanding in terms of knowing the content and format of a questionnaire. Their responses allowed her to decide whether her students were ready or not to write a questionnaire for their own projects.

Participant 07 used three different tasks and activities during her lesson to collect evidence of student understanding that were appropriately aligned to the learning goals and provided evidence of student progress toward the goals. She elicited and interpreted students' understanding using pre-reading tasks. She allocated some time for a brainstorming activity and then a predicting activity. These two activities, conducted via Quizizz, allowed her not only to know her students' understanding but also to make informed decisions as to whether to pre-teach vocabulary or to proceed with the session as planned. The reading passage which was from the students' textbook, followed by a post-reading task (a set of reading comprehension questions) were both conducted toward the end of the lesson as an exit ticket activity. The discussion which was held while reading provided her with opportunities to collect evidence about her students' understanding. The instant responses for these activities provided tangible proof of students' learning.

Participants 05 and 12 were scored at Level 3 (Progressing). They were able to elicit students' understanding through different ways but they both did not give their students adequate time to answer. They were always in a rush to get to the next instruction. The allocated time was not sufficient for each task, and it was notable that students required more

time to think, process the language and reflect. Consequently, the lecturers did not get a clear image of their students' learning progress. However, the connection between the activities and the tasks were frequently well aligned. For example, Participant 12 first assessed her students' prior knowledge using "Meeting Chat", in which not all students submitted their replies and then she checked their understanding after explaining a new concept using "MyELT" platform. The evidence collected from the few responses allowed her to shape the second part of the lesson based on the students' needs. She ended the class by dividing the students into pairs to enact a short conversation using the new taught language.

Participant 10 was located at Level 1 (Beginning). He rarely asked questions during the lesson except questions like "Are you with me?", "Do you understand my point?", and "Do you have any questions?" His focus remained teacher-centred throughout the lesson.

7.2.2 Providing Feedback That Moves Learning Forward

Although the participants showed marked improvement in the effectiveness of formative assessment practice informed by technologies according to where they were situated on the measurement rubric, their provision of feedback only marginally improved. The intention was to see if students were provided with feedback that allowed a record of not only what they were doing well, but also provide guidance on what needs to be improved as far as learning goals were concerned.

Participants 02, 07 and 10 were located at Level 2 (Developing). Participant 07 collected sufficient data about student learning using a series of well-crafted tasks and activities related to the reading text; however, Participant 07 did not make use of the students' collected data. She proceeded with the lesson as planned. The graph presented through "Quizizz" showed that most students were not familiar with the vocabulary presented to them. She did not modify the lesson plan nor provide effective feedback and the same action was carried out with the comprehension task. There were students who seemed to be

struggling in understanding the content. She provided corrective feedback, stating right and wrong answers but did not identify that the loading in some questions was on the vocabulary which was not the focus of the question. Participant 07 was located in Level 2 (Developing) in both providing feedback and using evidence to adjust instruction. The post-feedback discussion with Participant 07 concentrated on how to make use of the data collected, evidence of student understanding during the lesson to provide specific, actionable feedback that guides future learning and informs decisions on what should happen in the future. Participant 02 used “Class Point” to conduct activities in her “listening and speaking skills” lesson. This lecturer just gave correct and incorrect answers without any further feedback. Participant 02 did provide some corrective feedback on the students’ proficiency on the speaking activity to help them improve their accuracy.

Participant 12, who was evaluated at Level 3 (Progressing) provided oral feedback on students’ responses. For the first task, she asked students to write the correct answer in the chat. She commented verbally on the responses where there was a need, or just replied using emojis (happy or sad face). Moreover, frequent opportunities were provided to engage students in a very short discussion to deepen their thinking. For instance, when a student submitted a wrong answer, she asked him/her to justify his/her answer by asking “What do you mean by that?”, “Is it singular or plural?” or asking the class “What do you think about this?” This can deepen their thinking and help them better understand their own responses. Although oral feedback is considered as less formal, it should not be underestimated. According to Chappuis (2012), oral feedback can be a very effective and powerful tool. It can be easily provided during the “teachable moment”, and in a timely manner.

Participant 06 was located at Level 4 (Extending) in this component. She provided the students with individual written and actionable feedback on their writing, so they could use this in producing a 2nd draft of writing. Participant 06’s lesson was basically providing

feedback on their submitted written work using “Incident Report” and adjusting instruction based on the feedback and the students’ needs. The students submitted their written work earlier in “Class Notebook”. She checked their submissions prior to the lesson, highlighted and wrote the weaknesses for each student’s paper embedded in “Class Notebook”. During the lesson, she focused on their common mistakes and how to improve them, then she used an extract from a student’s writing to analyse the parts of the incident report. For instance, she recognised that her students depended on “Google Translate” in which she wrote the sentence in Arabic and it automatically translated the sentence for them to English. This led them to have a structure either semantically or syntactically incorrect. Hence, she displayed in a PowerPoint their sentences and asked them to correct their own mistakes.

Additionally, by providing exemplars, using extracts from a student’s writing from “Class Notebook”, she underlined the mistakes and asked students, “What is missing here?” “What shall we add?”, “How should we edit this sentence?”, etc. She provided them with hints, cues, and prompts to avoid explicitly presenting the correct answer and providing opportunities to deepen their thinking and understanding their own work and that of their peers. They were able to edit the sentences in “Class Notebook”. She also assigned an activity in which they could edit in groups and the last activity was done through “Padlet”. For all activities conducted during the lesson, immediate feedback was provided through SRS technology, which provides performance-related information in real time.

7.2.3 Providing Opportunities for Students’ Self-assessment

It was observed in some classes that lecturers used SRS tools and the available resources in MS Teams to provide opportunities for students to assess themselves. The most important aspect of this activity is that it should provide opportunities for students to think metacognitively about their learning. Most participants were located at a higher level in this component, either Level 3 (Progressing) or Level 4 (Extending). For example, Participants 05

and 12 utilised the “MyELT” platform as a means for students’ self-assessment. Participant 02 provided self-assessment opportunities during the “Listening and Speaking” lesson in two ways. First, the students had a short listening task and then went through a “Guided Speaking Task”. The students were able to assess themselves. The speaking task allowed them to work on their metacognition and work on the vocabulary. In other words, the activity allowed them to voice their thinking.

In the same way, Participants 04 and 06 provided several opportunities for self-assessment. They provided avenues for each student to compose and then reflect on their own writing. They offered them opportunities not only to promote their understanding but also demonstrate their capacity for critically analysing their own work. Doubtless, providing opportunities for peer and self-assessment can equip students with certain skills like analysis, critical thinking and problem-solving as well as encourage them to be autonomous learners. This process should help lecturers close or bridge the gap between the current learning and the attainable learning goals.

7.2.4 Classroom Culture

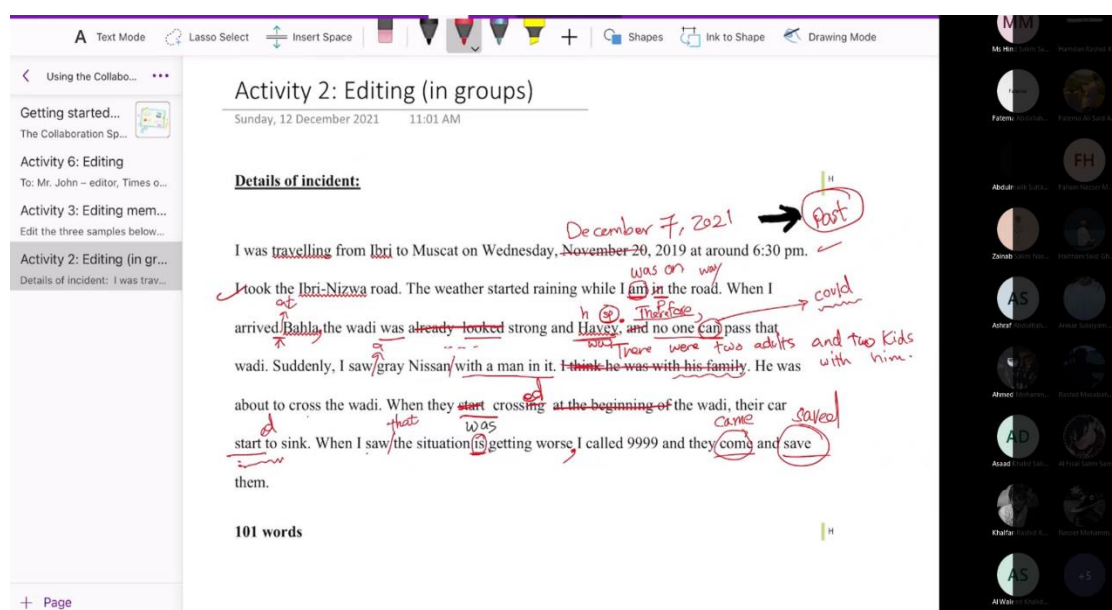
The participants were observed creating a collaborative culture of learning. They created an atmosphere where lecturers and students were part of the learning process. It was also observed in some classes that the students were empowered to take control of their own learning experience, e.g., conducting activities using the “Collaboration Space” in “Class Notebook” in MS Teams. Most participants were also located at either Level 3 (Progressing) or Level 4 (Extending) except Participant 10 who was rated at Level 1 (Beginning).

Participant 06 engaged students in an “editing in groups” activity (Figure 7.1). The students were divided in six groups and each group was provided with a text (one paragraph from an incident report: details of incident paragraph). The “Collaboration Space” was used during the previous lessons as well, so the students knew how to work because only those

students who were assigned to that group could edit that space. The lecturer mingled with some students and moved some students from one group to another. She showed the new groups how to process the information prior to the activity. The students were asked to discuss and edit the paragraph in groups within 7 minutes. After that, class feedback was provided by the lecturer on the activity.

Figure 7.1

ClassNotebook in MS Teams as a Platform for Editing in Groups Activity



Participant 02 divided the class into four groups for a “guided speaking task”. Topic-specific vocabulary was provided for each group. While students were working in groups, the participant roamed around checking their progress and provided feedback. She allowed them to use their digital devices to look up words if needed. Later, each group presented the topic and the lecturer focused on their fluency.

Similarly, Participant 11 asked her students to work in groups, (3-4 students) to develop questionnaires for their projects using “Microsoft Forms”. Each group had a different topic. The students were allowed to use different resources and she walked around, assisting students whenever necessary and following their progress. Likewise, Participant 07 allowed

her students to discuss their ideas with each other (in pairs). They brainstormed the ideas with each other, sharing their thoughts and fostering their speaking skills. Participant 12 also showed a good example in creating an engaging classroom environment. The students were actively involved in the learning process and they sometimes asked the lecturer to clarify if they misunderstood something or needed more clarification; this was rarely observed in the other classrooms. Another important point was that Participant 12 asked them to choose their pairs for the conversation – this is a strategy that can provide students the autonomy to determine the path of their learning process. Others, however, had already organised the students' groups.

7.2.5 Instructional Adjustments

The participants were observed using “Scaffolding” strategies to adjust their instruction such as simplifying the content, reteaching, using L1, using exemplars and graphic organisers, and providing hints and cues, guided instruction, etc. For instance, Participant 02 used scaffolding techniques by eliciting meaning through simplifying the language and giving examples.

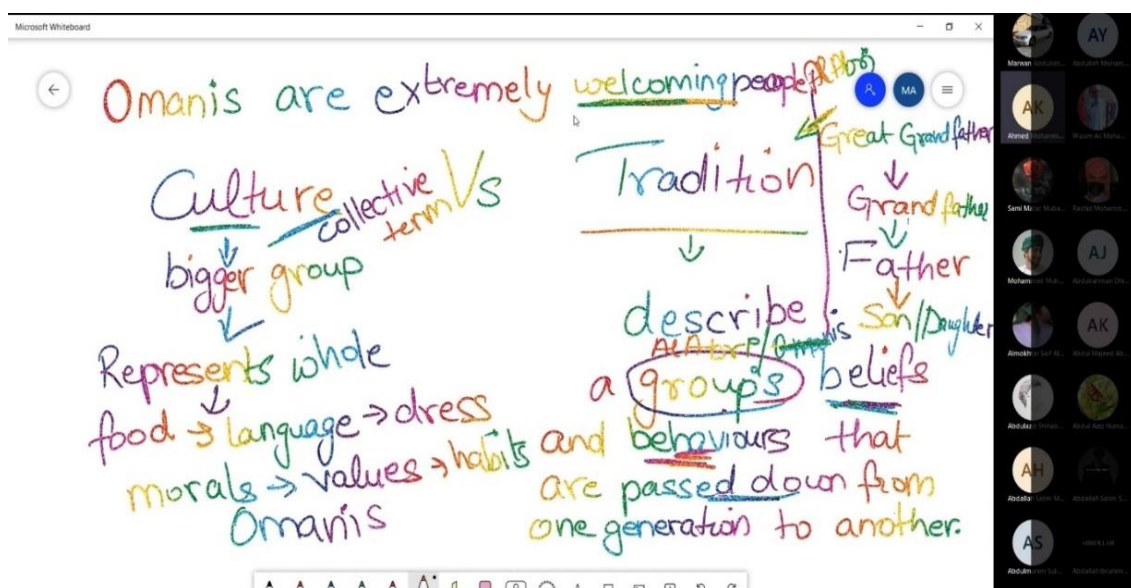
Another example of scaffolding was from the lesson given by Participant 06. This respondent's lesson required her to move on to the next learning activity, but she noticed that her students needed additional modelling and more guided practice. Her students wrote an “incident report” and during the lesson she focused on the common mistakes in their writing. This was followed by an analysis and discussion of each part of an incident report. She noticed from the students' written work that the most common mistake was misusing the tense of the verb. Therefore, the first warm-up activity on the verb tense was done through “Quizizz”. Based on the feedback received from students' writing submitted in “Class Notebook” and the activities conducted, she displayed a sample of a student writing as an “exemplar” and referred to the first part of the “the heading of an incident report” and asked

students “What is missing?” She then moved to the second part and asked them “What do you think about the description part?” She ended the lesson by providing an incident and asking students to “write at least two causes of the incident given by the teacher” using their “Padlet”. Three different short activities were conducted during the lesson based on students’ written work.

Participant 12 used scaffolding techniques through reteaching the concept. For instance, when she noticed that her students were still making mistakes, she showed them again the grammar chart with examples and highlighted the rule again. Not only in grammar but also during their conversation she noticed that they did not understand the difference between “culture” and “tradition”, so she explained the differences with examples. She illustrated her explanation through drawing using “Microsoft Whiteboard” as shown in Figure 7.2.

Figure 7.2

Scaffolding Techniques through Reteaching the Concept Using “Microsoft Whiteboard”



7.2.6 The Use of Technology

Technology was deployed as a teaching platform in most of the observed classes. As mentioned above, MS Teams was used during the recent coronavirus emergency to deliver the course content. SRS technology used for formative assessment purposes included “Quizizz”, “Kahoot”, “Class Point”, “Padlet” and resources in MS teams like “Class Notebook”, “Collaboration Space” and “Microsoft Forms”. All the participants used one or two of these tools to gather information about student learning and provide automated and instant feedback, except Participant 10 who was located at Level 0 (Not observed) in this component. He did not use any SRS technology, nor did he make use of MS Teams for formative assessment purposes. The remaining participants were located at either Level 3 (Progressing) or Level 4 (Extending) because they were able to utilise certain digital tools to conduct formative assessment activities, collect immediate feedback and adjust instructions accordingly. Participants 06, 07 and 04, located at Level 4 (Extending), were able to effectively integrate “ClassPoint”, “Quizizz”, “Class Notebook” and “Padlet” to conduct formative assessment activities. They used the information shown in the chart to adapt their teaching and plan the next steps in learning sequence to meet the students’ needs as well as help them progress in their learning.

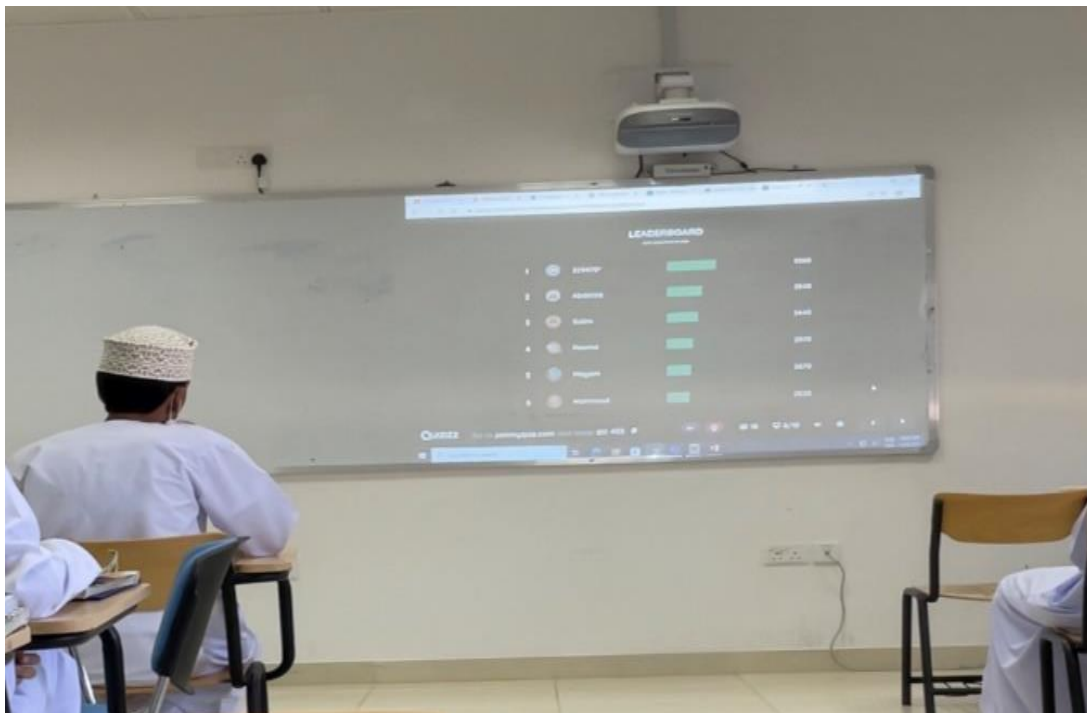
For instance, Participant 06 used “Quizizz” for the warm-up activity (Figure 7.3). She took advantage of the chart view which was provided after each question to get a glimpse of her students’ understanding and act on that feedback. Students also can instantly view their responses. She retaught an aspect that many students failed to answer correctly. She also provided scaffolded support to students who needed it, as well as opportunities for self-assessment, engagement and facilitated competition among them. Everyone wanted to be at the “Leader board” that was automatically created by “Quizizz” after each question displaying their ranking (Figure 7.4).

Figure 7.3

Using “Quizizz” to Collect Instant Feedback

**Figure 7.4**

Leader board Display after the Activity



She has also used the “Collaboration Space” in MS Teams to allow students to work in groups and do the assigned task; she concluded the lesson using an exit ticket activity that was done through “Padlet”. The students were able to complete the task with no or minor errors and that meant her students understood the taught concept and she was able to reach the intended learning goal.

Another point to highlight is the pleasing impact or change by those participants who were initially reluctant to use any digital tools. Participant 02 was unwilling to implement technology-based formative assessment in her classes during the first pre-observation session, but she used it effectively during this current session. Moreover, the potential to be creative in using technology beyond posing questions has been observed in some classes. For instance, Participant 11 allowed her students to use “Microsoft Forms” to write questions for their projects and they shared the link with her. She then utilised the instant responses to focus on the common mistakes made by her students. Additionally, “Collaboration Space in Class Notebook” was used by Participant 06 to allow students to work collaboratively in real-time. Participant 06 was able to correct misconceptions and provided scaffolded support based on the students’ work.

7.3 Post-Observation Feedback Discussion #2

The post-observation feedback discussion was also conducted during this stage following the same procedures as prior to the PD phase. Clearly, it is unlikely that the researcher would be able to observe all the components of formative assessment in a single lesson due to the nature and the objectives of the lesson. For example, it was hard to measure the quality of feedback from observation of a single lesson. Sometimes, there was a need to know the previous and next scenarios of how the lecturer provided the feedback and in turn how students improved based on the provided feedback. Additionally, there were instances in

which differentiated instruction was required to meet the needs of each individual student but none of the participants changed their instruction method during the observed lessons.

During the post-observation feedback discussions, the lecturers verified their formative assessment practice and reflected on their implementation and self-evaluation of it informed by technologies. For example, there was a discussion with Participant 07 about neglecting the data collected from the “Quizizz” activity that moved her location to Level 2 (Developing). She clarified that she usually interpreted and made instructional adjustments when necessary but for that observed lesson, and she did not make use of the data because of time constraints and the timed delivery plan. They were approaching the end of the semester and they had to complete the assigned delivery plan and course content. The same applied to Participant 11. She rated herself at a higher level in the feedback component. She indicated that two consecutive lessons were planned for the subject and feedback was to be provided in the second lesson. She also noted that she usually provided delayed feedback for writing activities and she was monitoring her students’ writing progress over time based on the feedback provided.

Participant 10 mentioned it was difficult for him to integrate SRS technology. He felt that his students and their usual excuses on having poor Internet connection would not support the practice. He also reviewed the feedback provided by the researcher on his lesson and noticed he was located at the lower levels on the measurement rubric. He said that he would prefer to follow his regular way of teaching as it does not require technology. Additionally, he regarded formative assessment as a complex practice, and it took time to be implemented. It is thus no surprise that he was assessed at the lower levels on the components. Overall, the findings of the classroom observations conducted at the end of the study showed a significant improvement in comparison to the initial classroom observations conducted prior to receiving the PD program.

7.4 Findings of Interview Data #2

This section presents the changes in the participants' understanding after receiving the PD program and further explores Research Question 4. The interview that was conducted toward the end of the study provided some evidence regarding the extent to which the professional development program may have improved participants' understanding of formative assessment practice informed by technologies. Table 7.2 presents the three identified themes from the final interview which were: (1) Gain in knowledge and shift in beliefs, (2) Developed understanding of FA pedagogical practices and its key components, and (3) Supports and barriers to the implementation of formative assessment practice and associated technologies guide. These inform the following section and focus the reader's attention on the central elements of this thesis.

Table 7.2

Inductively Developed Thematic Categories from the Interview Data #2

Codes	Themes
1. Defining formative assessment	Gain in knowledge and shift in beliefs
2. Knowing the purposes of FA	
1. Communicating learning goals	Developed understanding of FA pedagogical practices and associated technologies
2. Eliciting evidence of student learning	
3. Interpreting the evidence	
4. Providing feedback	
5. Instructional adjustments	
6. The use of technology	
1. Time constraints	Barriers to the implementation of formative assessment and associated technologies
2. Mandated	
3. Curriculum pacing	
4. Internet issues	
5. Lack of student motivation	
6. Lack of student engagement	

1. Professional learning communities	Supports to the implementation of formative
2. Initiative collaborations	assessment and associated technologies

7.4.1 Gain in Knowledge and Shift in Beliefs

The participants' knowledge of and beliefs about formative assessment changed toward the end of the study. When they were asked the first question in the final interview: "Has your definition, understanding the purpose and practice of formative assessment changed from the beginning of the study until now?", almost all of them reported that after attending the PD program they became more knowledgeable about formative assessment. For instance, the participants were no longer locked into believing that formative assessment necessarily comprised formal quizzes, tests, and examinations. Participant 05 disclosed, "I used to think that formative assessment would only come in formal structures like written assessments". Likewise, Participant 06 stated:

At the beginning I thought that formative assessment is all about quizzes and other assessments and then we give marks. Now I know that we get evidence from those tools and then we try to identify the gaps and then then try to close that gap
(Participant 06, Interview 2).

By understanding the comprehensive definition of formative assessment, the participants have also become more acquainted with its purposes. They expressed their thoughts regarding the reason for formative assessment in different ways. Participant 04 said, "It's not only about my instruction but also about student understanding so while I'm teaching my classes I have to consider it more than I ever used to". Participant 02 explained that "When I implemented formative assessment after attending the PD, there was a difference in my approach". Participant 06 stated that, "Once we identify the gap, we need to modify our instruction and close the gap" while Participant 07 indicated that "It is a timely process; it is done to adjust your instruction".

7.4.2 Developed Understanding of Formative Assessment Pedagogical Practices and Associated Technologies

The interview data collected at the end of the study confirmed there was a visible and considerable change regarding the participants' knowledge about the ways of implementing formative assessment practice and associated technologies. Their responses to the second question of the final interview, "How do the processes of eliciting, interpreting the evidence and adjusting instruction work to close the gap?" and the question "Did you introduce or notice any other changes as a result of PD sessions in your teaching practice?", showed that they had a sound understanding of the formative assessment cycle. Their responses indicated the extent to which they became familiar with the pedagogical practices of formative assessment and its key components.

Participant 04 acknowledged that after she attended the PD, she noticed some changes in her classes that made her aware of the students' needs. She became aware of the importance of sharing and communicating learning goals, feedback, and adjusting instruction. She said, "I think after your professional development I underwent a paradigm shift in my understanding of the process of formative assessment." She proceeded, "I find myself doing more and more activities earlier. I used to rely more on questioning but now I feel that my students are more informed about their learning progress. I get a holistic picture so that is how my tracking has changed". She added, "When I see my students' responses during formative assessment, it is food for reflection, and I think about what I can do better to close the gap in my next session and also in not only about the next session and not only about the particular section and teaching, but I think it also adds to my overall teaching quality."

Participant 04 was observed during the pre-measures stage (Stage 2) using formative assessment with the help of technology. She said, "Earlier on I thought I knew what it is, but I really did not really know how to implement it. But after implementing it I think

unknowingly a lot of things have changed.” She provided an example of how the change happened in forming questions:

I write my questions in such a way that I can get whether my students really understand the concept or not. In addition, I also think I have happier students because I have also felt that my students are a little bit more responsive now because they feel they are part in the decision-making process. They are more active maybe because they feel that whatever is happening is more relevant to them. They are more like stakeholders now. (P04, Interview 2)

It was evident that Participant 04 demonstrated an improvement in her classroom practice. She was located in Level 4 (Extending) in almost all the components on the measurement rubric.

It has also been noticed that the participants’ language used to describe formative assessment has changed from the initial interview. They used some terminologies that were presented and discussed during the targeted professional development program. For instance, Participant 05 responded:

I close the student gap through feedback when you see that for example a particular item has gained a lot of wrong answers from students then you would close the gap by simply discussing on it and then give them another activity related to it and then give them feedback. It is just a continuous cycle of repetitive activities that are designed to close the gap. (P05, Interview 2)

The participants also indicated how they provide feedback to their students has been changed. Participant 05 described the changes in her way of providing feedback. She said, “I used to give feedback in writing skills but not much for other activities but now I tried to provide feedback in all the skills whenever needed, not just haphazard”. Indeed, Participant 05 demonstrated an improvement, moving from Level 2 (Developing) to Level 3

(Progressing) in feedback component. Similarly, Participant 07 indicated that she had become more focused while providing feedback and adjusting instruction. She also stressed the value of having instant feedback and providing effective feedback. She said, “I did see the value of giving feedback soon after the task instead of just giving them the numbers. I was kind of taking it more like a summative approach”. She also added, “I know by now that I should be scaffolding and giving them the techniques, they are lacking”.

The third question asked during the interview, “To what extent is technology used to support formative practice?”, targeted the impact of using technology and SRS tools that were explored during the 4th session of the professional development program. The respondents’ replies showed a positive attitude toward the use of technology in general, and specifically towards SRS. They felt that SRS could truly support the practice of formative assessment.

Participant 02 was teaching on-campus and she used “ClassPoint” to collect timely data. She said, “I found “ClassPoint” very useful. You can show it as a slide in a PowerPoint and recording responses was very fast. You can just get immediate graphs and then record their responses. It helped me to engage every student in the class and no student was left behind” She also found that using “ClassPoint” generated interest and engagement among students. She said, “The energy in the class was incredible, especially when I taught vocabulary development and grammar lessons”. It is worth noting that, during the initial interview, Participant 02 was reluctant to use technology and tried to avoid such tools.

Participant 04 found that SRS for formative assessment is effective not only for lecturers but also for the students. She described them as “digital natives”. As for integrating SRS, she made the point that, “It gives me a clear picture of my students understanding. It is quicker and easier to keep records for reflection purposes”.

Participant 05 who was already teaching online, noticed that SRS technology provided a boost to supporting the whole learning process. It enabled her to “make sure that my students stay on track or at least somehow keep them on track with the lessons and things they need to do for improvement”. She also clarified, “There is no chance for me to meet my students physically so what I can do is maximise and exhaust technology to facilitate learning, so I used functions and features of the “Class Notebook” in “MS Teams”. Indeed, Participant 05 showed a significant improvement from being located at Level 1 and Level 2 on the measurement rubric prior to receiving the PD program, to Stage 2 to Level 3 (Progressing) on all the components on the rubric.

Participant 06 used “Quizizz” and she stated that, “I have a better idea about my students’ weaknesses and strengths. It is useful to keep a record of the results and give feedback within the application or the website”. Participant 07 shed light on the value of the transitional shift from paper-based assessment methods to SRS for formative assessment. She explained, “It supports me a lot instead of collecting their papers and giving that feedback one by one, with this technology I can, just with the click, I can see what everybody has done even the graphs are made which is quite helpful”. She also echoed what Participant 04 said about today’s students and their passion for technology. She said, “Students love technology. They are 21st century students, so they are quite at ease using the technology and somehow, they are more engaged when technology is used, so I think it helped me greatly”.

According to Participant 11, SRS technology has indeed supported the practice of formative assessment. She can now view the process of formative assessment through the lens of SRS technology:

Since we are teaching online, it’s the only thing that we have in terms of being able to understand where students are and where they need to go like where they’ve been where they are now what they need to learn to achieve the goal. I used Kahoot and

Quizizz which are both fun and engaging and allow me to understand if they grasp the information that's been presented. In the last three weeks those have been super helpful and fun. (P011, Interview 2)

7.4.3 Supports and Barriers to the Effective Implementation of Formative Assessment Practice and Associated Technologies

The third theme identified concerns supports and barriers to the effective implementation of formative assessment and associated technologies.

7.4.3.1 Facilities That Support the Effective Implementation of Formative Assessment Practice and Associated Technologies. The participants' responses to the 4th question of the interview "To what extent can the tailored professional development program and applied measurement rubric support you to understand and apply formative assessment practice and associated technologies?", revealed that the program and measurement rubric greatly supported their understanding and practice of formative assessment and associated technologies.

Participant 02 suggested that, "When the rubric was provided to the team, we went through those minor details, the details helped us kind of reflect upon our teaching style". She continued, "It helped me to look at students minutely, record observations, plan the classes and customise our instructional approach". Participant 04 said that, "The rubric streamlined things to the point where it covers all the process of formative assessment and that is all we need".

The participants also reflected on the impact of the professional development program with Participant 02 pointing out that the details presented were interesting. She stated, "What I found interesting is how to go into those minute details which we sometimes ignore, and we tend to overlook so that part helps me a lot". Participant 04 claimed that the measurement

rubric was helpful, but the professional development program provided her a broader support.

As well, she commented:

I would give more credit to your professional development sessions because while reading the rubric, you have a lot of questions that you don't have answers for, so your PD sessions were more a free crash course on formative assessment, and I thoroughly enjoyed them. (P04, interview 2)

Participant 05 explained:

I'm sure that there is always room for improvement and especially in my case relatively being new here. The rubric somehow served as a guide for me to follow and the professional development program and assisted me in doing things more efficiently". (P05, interview 2)

Participant 06 showed minimal knowledge during the initial interview and in turn she showed her interest in knowing more about technology-based formative assessment during the PD program. During the PD sessions, she kept asking questions regarding the successful implementation of formative assessment process. She expressed her struggles in providing effective feedback to her students. She said, "I usually give written and oral feedback, but my students kept making the same mistakes over and over". She showed the desire and the willingness to break the old habits of her teaching practice and adopt new ones. She expressed that the PD program added to her knowledge and use of technology-based formative assessment. She said, "I came to know many new ideas starting from the definition of the formative assessment and then I came to know the whole process of formative assessment practice".

Participant 11 admitted that she did not use the measurement rubric to evaluate herself, but she appreciated the reflection and sharing activities that were conducted during the sessions of the professional development program. Moreover, she benefited more from

the practical session where they performed mini-lessons. She said, “I really like hearing the different ideas that people are doing in terms of formative assessment. She described the PD program as “collaborative meetings”. She further illustrated that, “knowing the theory is really good but what’s really important is to apply those theories in a real-world context”.

Participant 12 used the measurement rubric to evaluate herself and she noted that the levels of proficiency provided in the measurement rubric allowed her to “see where I am and then what I can apply to get better with the help of the indicators to make the overall learning better”. Apart from the professional development program and the measurement rubric, Participant 07 valued the post-observation feedback discussions:

Post-observation feedback discussion after the class had helped me greatly because I could see that from a third person. How the things were done and what are the things which I couldn’t see where [I was] going wrong and somebody tells me what to do and I think I learned to pausing myself and giving feedback before moving to another task. (P07, Interview 2)

The use of SRS tools was also welcomed by the participants. Participant 02 was not technically inclined. However, when she was introduced to SRS tools and practiced during the last session of the professional development program, she seemed to be convinced that they would contribute to her pedagogy from now on. The observational data showed that she used “ClassPoint” and she used it for a warm-up activity. She stated during the interview, “The use of SRS technology allowed me to record students’ responses very fast and you can also show them, and this particular app helped me to engage each and every student in the class and no student was left out and they generated also a lot of interest”.

7.4.3.2 Barriers to the Effective Implementation of FA Practice and Associated Technologies. It is also important to highlight here that the interviewees revealed certain challenges that hindered effective and consistent implementation of formative assessment

practice. These perceived barriers were: (1) limited pedagogical and technological knowledge, (2) mandated curriculum pacing, (3) heavy teaching load, (4) time constraints, (5) poor internet connection, and (6) student-related issues like too many students in one class, their level of proficiency, low-level participation, and lack of engagement.

Participant 06 commented that there are still many lecturers in the ELC, UTAS-Ibri who shy away from technology. They are lacking knowledge on how to fully make use of the power of the available technology tools to enhance the teaching and learning process, and actually make their job simpler. According to her, “There are teachers who still don’t like to use technology and that means they will not be able to use the measurement rubric efficiently to evaluate themselves”. Participant 01 frankly stated, “I’m not into technology”.

Poor internet connection was the most common barrier experienced by Participants 01, 03 and 10. They stated that slow internet connection with students was a major hindrance and in turn, affected their participation. They said not all students were able to access the assigned activities and sometimes the online teaching platform (MS Teams) was not available.

Participant 10 expressed his frustration in using SRS technology. He said, “I could not handle it well in my class and my students were not supported. I’m teaching them online and I don’t know what is going on behind the screens”. Two participants mentioned time-related barriers may affect the consistent implementation of technology-based formative assessment. Participant 07 said “Sometimes some students will not go anywhere. They will need more and more, and you feel pressure. We are having a delivery plan which we must follow so we cannot get stuck”. Participant 08 affirmed this, as follows: “Due to the number of the students, it takes time to provide effective feedback to my writing class”. Both participants conveyed the sense of concern about not being able to finish the course content within the allocated time.

The students' linguistic proficiency level was another barrier mentioned by Participant 07. She remarked, "Some students are just based in the wrong level, so they need a lot even my formative assessment tells that they're still behind, but I don't have time. I must cover my syllabus and my delivery plan". Students in the General Foundation Program (GFP) at UTAS are usually placed in levels according to their performance in the entry test known as the "Placement test". However, Participant 02 felt that some of her students were wrongly placed in that class. She meant that their linguistic proficiency level indicated that they were supposed to be in the elementary or intermediate level classes, but were now in fact in a higher-level class by mistake. Participant 07 made a point that having mixed-ability classes made it more difficult to close the gap in the students' learning and this problem delays the schedule for the pre-planned course syllabus and delivery plan.

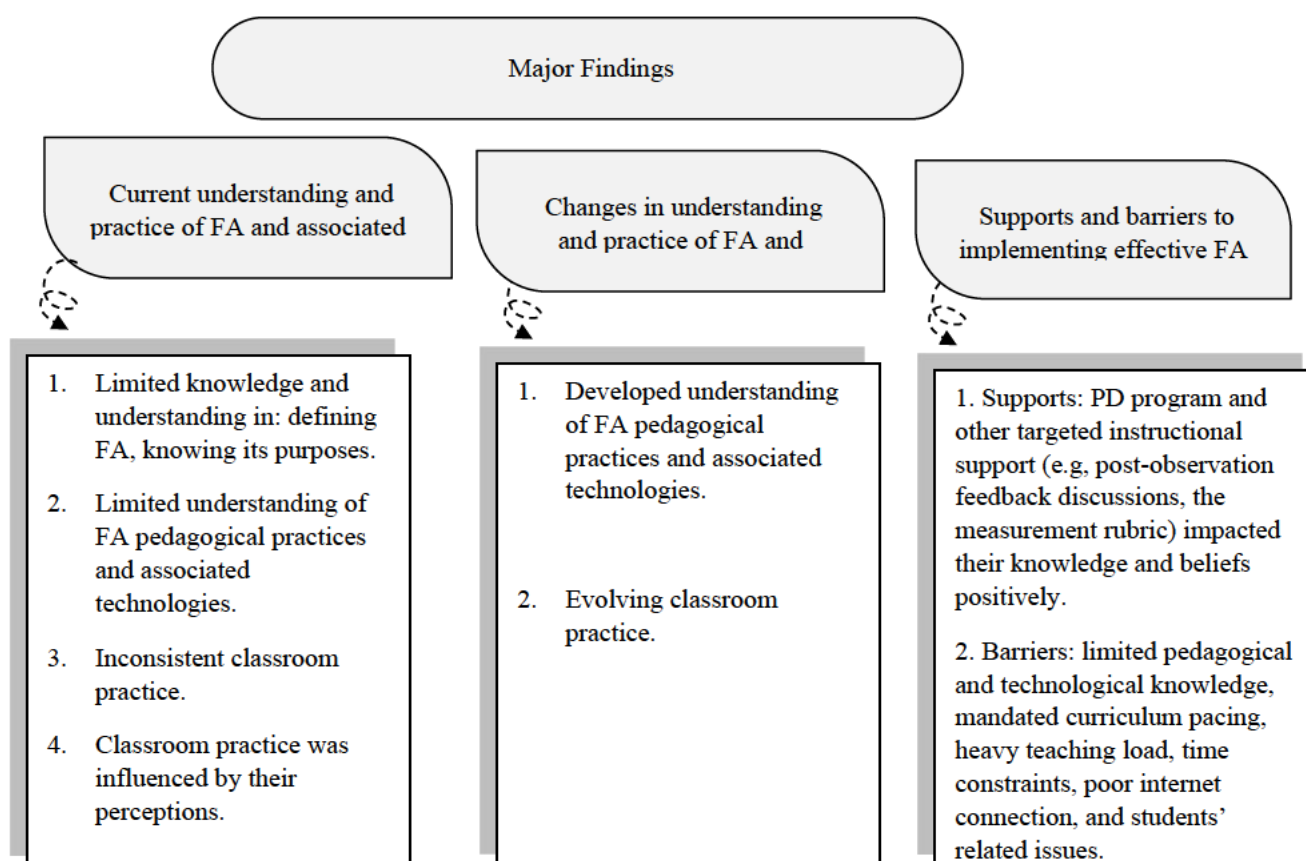
Participant 09 believed that technology should not be integrated in the language courses. She argued that "technology sometimes impedes their language learning, too much technology interferes with language learning." According to her, "if you use technology in other courses like engineering or business studies it is reasonable, but when it comes to language, especially certain skills, you know you just cannot learn language at the click of a button". It could be that the current situation of having to suddenly shift from face-to-face teaching to online teaching and the difficulties they encountered to cope with the current situation, made them more frustrated about using technology.

7.4.3.3 Suggestions to Further Improve the Measurement Rubric and the PD Program. In response to the last question posed during the interview "In what ways can the PD program and the applied measurement rubric be further improved?", the participants provided several suggestions. Participant 05 recommended having professional learning communities with the same content. She advised that a larger group could implement technology-based formative assessment and interact to better improve the practice and

improve students' results. She reported, "I'm sure it can help a lot of lecturers who are experiencing some difficulties in handling students and giving feedback". She proceeded, "they can benefit from each other especially on giving feedback without consuming a lot of time". Participant 01 also suggested that peer observation should be part of the PD program. He thought that attending classes with colleagues and then evaluating their practices using the measurement rubric could enhance their understanding and practice of technology-based formative assessment. According to him, "practical knowledge is more important than theoretical knowledge." As for the measurement rubric, Participants 02 and 06 suggested it is a good idea to produce a version of the measurement rubric without the technology component. According to Participant 06, "I'm currently using various technological tools and I found them really effective to serve formative assessment and to facilitate its practice in the classroom, but I think there are lecturers who still need more training on how to use technology for formative assessment and to deal with the challenges they encountered".

Figure 7.5

Summary of the Findings (Stages 2-4)



7.5 Summary

This chapter illustrates the extent to which the participants improved their understanding of formative assessment informed by technologies and its applicability in their classrooms after receiving the professional development (PD) program. The findings were discussed within the outline of Research Question 4 and aligned with the thesis's theoretical and conceptual framework. Generally, the findings indicated that there was a significant change in favour of post-PD phase results (class observations and interviews).

The findings of the classroom observations showed participants' evolving practice of formative assessment and associated technologies as it was reflected in their ratings on the measurement rubric. This improved practice reflected their transformative understanding of formative assessment as an ongoing process. Some participants were able to successfully transfer the knowledge and skills gained in the PD program to their classrooms whereas a few others encountered obstacles. These included limited pedagogical and technological knowledge, mandated curriculum pacing, heavy teaching load, time constraints, limited network resources (poor internet connection), and other student-related issues like large number of students in one class, students' level of proficiency, low participation, and lack of engagement.

The analysis of the participants' interviews showed that the (PD) program greatly assisted the participants. They reported that positive changes had occurred in their understanding and practice of formative assessment and associated technologies. The sessions of the PD program served as a catalyst for them to implement the technological pedagogical content knowledge gained. The measurement rubric gave them a clear and consistent framework for assessment and feedback by using it to measure the effectiveness of formative assessment practice informed by technologies.

Given these results, the PD program plays an important role in enhancing lecturers' technology-based formative assessment practice. The effectiveness was ultimately judged by its impact on the participants' understanding and implementation of formative assessment practice in their lessons. Strategies to mitigate the obstacles encountered should be taken into consideration in order to maximise the effectiveness of formative assessment implementation.

The next chapter provides a discussion and conclusion for the thesis. It addresses the research questions that have been developed, discusses the implications of the findings for practice and offers recommendations for future research.

Chapter 8: Discussion and Conclusions

8.1 Introduction

This chapter presents the outcomes addressing this study's research questions. Using a sociocultural constructivist view of learning, the study employed a mixed methods approach to determine the amount and effectiveness of formative assessment and associated technologies being conducted in a higher education institution in Oman, and to build and validate a measurement rubric for formative assessment practice, and associated technologies. The measurement rubric was developed to ascertain the effectiveness of formative assessment practice informed by technologies in a higher education context, and to monitor any changes in such practices after participants received a professional development (PD) program. The aims of the study were to:

- (1) Determine how much formative assessment is being carried out in the English language Centre (ELC) at the University of Technology and Applied Sciences (UTAS-Ibri), Oman, and how technology is used to support this practice.
- (2) Determine how well lecturers in this Centre use formative assessment and associated technologies in their teaching practices.
- (3) Ascertain the extent to which a professional development (PD) program, targeted at improving the understanding and use of technology-based formative assessment in higher education classrooms, can lead to improved understanding and practice of formative assessment.

The major contribution of this thesis is delivering a measurement rubric that assesses lecturers' effectiveness in formative assessment practice informed by technologies. It is a tool which enables lecturers to greatly improve their formative assessment practice. It provides lecturers the opportunity to reflect on their own practice and that of others and provides a

catalyst for discussions with colleagues about their relative strengths and areas for potential improvement.

In addition to the measurement rubric, a series of professional development sessions targeted at improving the understanding and practice of technology-based formative assessment in the higher education context has been developed as a potential key strategy to reform formative assessment. The following sections incorporate a critical discussion of the findings presented in Chapters 5, 6, and 7 and the literature that aligns with the main research questions. The chapter concludes with implications, limitations of the study as well as further suggestions for future research on this important topic.

8.2 Research Question 1: What are the key components of effective formative assessment practice informed by technologies?

It is important to critically examine the draft of the measurement rubric for establishing the evidential case (i.e., the validity argument) to support the content validity evidence for the measurement rubric. The approach to collecting validity evidence was based on evidence-based decision-making (Tognolini & Mowbray, 2019). It is a systematic and rational approach that involves using the best available evidence to make well-informed decisions. The evidential argument has several dimensions. One of these is the references to the literature that were used to build the draft rubric, and the initial draft followed those identified by Tognolini and Mowbray (2019). It started with defining the construct which was identified as the effectiveness of formative assessment enhanced by technologies. The components associated with this definition were then identified and defined. In the next step the components were differentiated in terms of proficiency levels which described growth along a developmental continuum. These first three steps produced the draft measurement rubric which was then the focus of the validation process comprising a focus group evaluating the extent to which the components, indicators, and proficiency levels in the draft

measurement rubric were representative of the construct. In other words, the focus group activities offered some evidence that gives confidence that the draft measurement rubric, when adjusted to accommodate the agreed suggestions of the participants, is measuring what it is supposed to be measuring.

The discussions and deliberations made by the focus group were ultimately unanimous in agreeing that the draft of the measurement rubric did align with the proposed definition of formative assessment with a need to add one more component. The participants in the focus group made the point that formative assessment involves not only lecturers, but also students, who are expected to take an active role in the education process. Consequently, the formative assessment component, “*Providing opportunities for students’ self-assessment*” and its related level descriptors were added based on their suggestion. This new formative assessment component makes it possible for lecturers to capture the opportunities for students’ self-assessment-related practices. As proposed by Wiliam and Thompson (2007) and discussed previously in this thesis, the process of formative assessment involves both lecturers and students. The fifth key strategy of Wiliam and Thompson is activating students as owners of their own learning. This means that students are encouraged to take responsibility of their own learning process, monitor their own progress, set their own goals, and seek feedback to improve their learning outcomes. This can be achieved through providing opportunities for students’ self-assessment.

Another very important outcome that emerged during the focus group discussion was the significance of the language competency and consistency of the structure. This led the participants in the group to concentrate on the clarity of the statements and provide suggestions related to using a descriptive language that shows growth across proficiency levels. Thus, certain phrases were changed for accuracy and clarity purposes.

Finally, based on the approved suggestions, the participants subsequently agreed that the draft of the measurement rubric was fit for the purpose of assessing lecturers' effectiveness of formative assessment practice informed by technologies. More specifically, the measurement rubric translated into practice the research-based formative assessment cycle proposed by Heritage (2010) and illustrated in Figure 2.1. The measurement rubric also incorporated the use of technology based on the study's framework (Figure 3.1). This produced a tool that the focus group participants were confident could be used in answering the question, "How effective am I in my practice of formative assessment informed by technologies?" Answers took the form of specific components and descriptors of proficiency levels. It captured the process of formative assessment and associated technologies and displayed it as a cycle.

The final version of the measurement rubric comprises six components: (1) Eliciting and interpreting evidence of student learning, (2) Providing feedback that moves learning forward, (3) Providing opportunities for students' self-assessment, (4) Creating a collaborative culture of learning, (5) Using evidence to adjust instruction, and (6) Using technology-based assessment. Its structure makes explicit the formative assessment process and as such, it can support formative assessment practices in enhancing teaching and learning. Lecturers can draw upon each of the identified components to create a dynamic environment that can encourage students to achieve their learning goals.

The validation process demonstrated that the measurement rubric had a degree of validity and was considered by the participants in the focus group to be an appropriate measurement tool for assessing the effectiveness of formative assessment practice informed by technologies in higher education courses. They were of the view that the potential of using such a measurement rubric lies in the fact that it explicitly provides a road map that, if

followed, could potentially lead to an increase in the effective practice of formative assessment in the higher education classrooms.

A third part of the validation process for the measurement rubric occurred during the development of the professional development program and its implementation. The participants were introduced to the measurement rubric in this program and had the opportunity to reflect upon the rubric and make suggestions as to how it might better reflect the construct. One person viewed the measurement rubric as a helpful self-assessment guide: “I can actually do some self-assessment and I can say whether or not I am giving my students the right path for them to take so that they will arrive at the destination that you want them to be”. They then had the opportunity to use the measurement rubric during the implementation phase.

The anticipation of the thesis is that the measurement rubric will be used with three overarching purposes: firstly, to understand the status and effectiveness of formative assessment implementation; secondly, to inform iterative professional development; and thirdly, to support systematic lecturer, self- and peer-reflection on practice. It is understood that like most rubrics, the meaning of the words used to describe the proficiency levels for each component will take time to be refined and become imbedded in the minds and activities of lecturers. However, as they use the measurement rubric and gather evidence (exemplars) that they argue is consistent with the meaning of each proficiency level descriptor (particularly indicative of the borderline standard), the usefulness of the measurement rubric will become more apparent and measurement precision will increase. This would require an effort by the various faculty staff to share the evidence, even when lecturers are carrying out self-assessment. It would also involve establishing a mechanism to include these exemplars in professional development programs.

The measurement rubric was intentionally developed for all stakeholders involving education policymakers, principals, and lecturers. It has the potential to be generalised across different disciplines in Oman and elsewhere. There is a need for more evidence to build the efficacy of the validation argument. There is certainly a need for more validation studies using argumentative approaches and including collaborations between experts from different branches of knowledge to strengthen the level and type of validity. For example, future studies could examine any unintended consequential validity that emerges from lecturers using the measurement rubric.

One of the key questions that has driven this thesis is “How do you know how effective you are in formative assessment practice?” In most practical instances, the answer to that question results in the lecturers indicating the strategies of formative assessment they use. They now have a tool which, if applied diligently, can provide evidence to answer the question. An example that illustrates this point involves the New South Wales Department of Education School Excellence Framework (SEF) (2017), where schools are asked to rate their performance on a range of aspects of school performance. Figure 8.1 shows part of the SEF for formative assessment.

Figure 8.1

School Excellence Framework (2017, p. 5)

THEMES	DELIVERING	SUSTAINING AND GROWING	EXCELLING
Formative assessment	Teachers collect and use assessment data that monitors achievements and identifies gaps in learning to inform planning for particular student groups and individual students.	Teachers routinely use evidence of learning, including a range of formative assessments to inform their teaching, adapt their practice and meet learning needs of students.	Assessment is used flexibly and responsively as an integral part of daily classroom instruction. Formative assessment is practised expertly by teachers.

If a school wants to be rated as “excelling”, what evidence for example, would they need to collect regarding “Formative assessment is practised expertly by teachers”? The measurement rubric that has been developed in this thesis provides them with a tool that would not only direct their focus on the type of evidence to collect to support their argument but would also give them directions on what they must do to improve.

It is important to stress that this thesis has identified a method. It is not arguing that the applied definition of formative assessment is the only definition nor that the components are appropriate irrespective of the definition. Instead, it is describing a method for developing measurement rubrics that can measure practices, activities and values in all education sectors.

A second point worth noting in addressing this first research question is that the thesis has stopped short of the final steps of measuring the construct. Tognolini and Mowbray (2018) stated that measurement in social and the physical sciences requires a 2-stage process. The first stage involves building the measurement scale (defining the construct, identifying the components, developing the proficiency level descriptors and building the evidential validity argument). The second stage involves measuring performance against the measurement rubric (collecting the evidence (assessing) and then using the evidence to locate the lecturer (in this case) on the rubric).

While a classroom observation protocol (Appendix M) was devised to assess lecturers against the measurement rubric in the study, it is just an example of the types of instruments or activities that can be used to assess against the measurement rubric. One of the advantages of using a measurement rubric like that developed here is that lecturers can generate their own evidence from a range of assessment sources and then use it to argue that they are in fact at a proficiency level for each component. Lecturers must consider ways that they can collect evidence and then reflect upon why the evidence that they have demonstrates a particular proficiency level. Of course, it would also be possible to develop the observation protocol,

validate it as an assessment tool and standardise the collection of data. The decision is within the remit of the faculty/unit/school that uses the measurement protocol and how it reflects its assessment philosophy.

A third point is that while there was an attempt to make the proficiency level descriptors equidistant; the images conveyed by the proficiency level descriptors represented images that were approximately the same distance apart in terms of performance. The participants were invited to comment on this during the focus group discussion, as there has been no formal attempt to calibrate the scale in this thesis. This could be done in future research using modern assessment theory; however, it was beyond the scope of this thesis. The next section addresses the second research question.

8.3 Research Question 2: How much formative assessment informed by technologies is currently being carried out by English language lecturers in a higher education institution in Oman?

To determine how much formative assessment is currently carried out at the University of Technology and Applied Technology (UTAS-Ibri), 12 lecturers from the English Language Centre (ELC) were interviewed (Appendix K). The interviews were conducted at the beginning of the study, prior to receiving a professional development (PD) program. Two themes emerged from the interview data: (1) knowledge and beliefs, and (2) formative assessment pedagogical practices and associated technologies.

Data showed that the participants had limited knowledge and understanding of what formative assessment implies in practice. For instance, they were asked to define formative assessment and their responses were analysed to determine what they understood. Only two participants were able to closely define formative assessment in a way that was considered close to the proposed definition.

The definition used in this thesis has the main components that are important to understanding the formative assessment process against which participants' responses were compared. Three interviewed participants were able to reveal several main components of formative assessment definition and provide examples of formative assessment strategies, for example questioning strategies. Six participants were unable to define it appropriately and one was unable to define it at all. Their responses indicated the degree of confusion between different kinds of assessments. Moreover, none of the interviewed participants were able to explain formative assessment as an ongoing process. A possible reason could be the dominant use of summative assessment. They viewed formative assessment through the lens of summative assessment. Table 8.1 summarises the participants' responses regarding formative assessment definition.

Table 8.1

Results from the Initial Interview on Defining Formative Assessment

Theme: Knowledge and Beliefs	Responses	No. of Participants
Defining Formative Assessment	Not able to define it	1
	Not able to define formative assessment appropriately	6
	Partially define formative assessment	3
	Closely define formative assessment	2

One of the primary requirements of being able to understand and implement formative assessment is to know what it means. Bennett (2011) commented that if a construct cannot be clearly defined, then it is difficult to measure its effectiveness. Similarly, if formative assessment cannot clearly be defined, it is difficult to know whether it is being implemented

as intended or not. That is, we cannot evaluate the effectiveness of executing formative assessment if we do not know what it is.

Additionally, the participants, through their responses about the purposes of formative assessment (e.g., “check students’ progress”) demonstrated a limited understanding of its purposes. They considered that its only benefits are checking what students know and understand, and they had little conception of the importance for lecturers themselves. They largely ignored the fact that formative assessment is a reflection for lecturers to assess their teaching and adjust their instruction style accordingly to enhance the quality of their work. Andrade and Cizek (2010) stated that the purposes of formative assessment are: “(1) identifying a student’s strengths and weaknesses; (2) assisting educators in the planning of instruction; (3) aiding students in guiding their own learning, revising their work, and gaining self-assessment skills; and (4) fostering increased autonomy and responsibility for learning on the part of the student” (p. vii). Indeed, formative assessment has several purposes for both students and lecturers and cannot be reduced to one.

The interview then progressed to ask about how the participants conduct formative assessment in their classes. Based on the coded transcript data, there was a variation in the participants’ level of understanding as well as the amount of formative assessment they currently conducted. They did not prioritise or pay much attention to the pedagogical practices of formative assessment. This includes communicating learning goals, eliciting evidence of student learning, interpreting the evidence, providing feedback to students, making instructional adjustments, and using technology in a guided way. Table 8.2 shows some of the responses indicating perceptions on how they implement formative assessment.

Table 8.2

Extracts from the Initial Interview on how Participants Conduct Formative Assessment

Themes	Extracts from the interview	Common Responses
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Communicating Learning Goals	“I don’t usually describe the lesson goals or lesson objectives” P01 “I show them the information on the screen in written format” P11	Posted online
Eliciting and Interpreting Evidence of Student Learning	“I usually give them assignments” P10 “Quizzes, questionnaire and mid-term exams” P08	Short quizzes, mid-term exams, and writing assignments
Providing Feedback	“I use writing correction symbols for their mistakes” P09 “I highlight the mistakes” P07	Written and/or oral feedback to indicate right/wrong answers
Instructional Adjustments	“Give more practice or reteach again” P07 “I change my methodology and the activities to meet the needs of students”	Reteaching and/or providing extra practice for the entire class
The use of Technology	“I don’t have any choice but to use a technology since this pandemic” P05 “I use ClassPoint at the beginning of a class to check their prior knowledge or at the end of the class to guide my next lesson” P04	MS Teams, Moodle, MyELT, SRS tools like Quizizz, Kahoot, and ClassPoint Mostly as a method to conduct online classes

As shown in Table 8.2, the most common means of assessing students was through written assessments such as graded quizzes and writing assignments. Not surprisingly, the English Language lecturers gave students written assignments due to the nature of their discipline. Surprisingly, some participants relied on a type of assessment that is typically used to measure students’ competency at the end of a unit or course (i.e., mid-term and final

examinations). In this study, the interviewed participants were of the perception that they are implementing formative assessment through continuous assessment. As discussed in Chapter 2 of this thesis, in Oman's HEIs, various alternative assessment techniques have been implemented, such as Moodle activities, portfolios, projects, presentations, etc. These forms are collectively referred to as "continuous assessment" (Denman and Al-Mahrooqi, 2018). The interviewed participants consequently equated formative assessment to continuous assessment. It is true that continuous assessments are formative in nature since they include various types of assessment such as quizzes, projects, assignments, presentations, etc. However, the problem is using continuous assessment in a summative way to evaluate their students by awarding them marks and grades, which are the only focus of this method. They limit the practice of formative assessment to graded assignments and quizzes as if they are the only forms of this kind of assessment. As noted previously, Al Kharusi et al. (2014) stated that continuous assessment is used in a summative way in Oman. What about observation or noticing which is naturally occurred during the lesson? None of the participants acknowledged these less formal strategies of collecting data as formative assessment.

Additionally, during the interview, the participants had an opportunity to indicate how they provided feedback from the formative assessment to their students. Interestingly, the participants showed a good understanding of the importance of providing feedback as their responses asserted that they gave feedback after each activity. However, they did not really have a complete understanding of what feedback means nor the many ways that it manifests in the classroom. Unfortunately, some participants considered feedback as merely stating the right and wrong answers captured in the assessment or grades. They also said that they adjusted their instruction to accommodate the learning needs, particularly when students did not grasp a concept. They generally relied on adjusting their instruction either through reteaching or providing extra practice.

In terms of using technology, all participants acknowledged using various tools such as Moodle, MS Teams, and SRS for several purposes. For example, all participants indicated technology enables communication and presenting information or content particularly during the COVID-19 pandemic. 10 participants reported the use of technology to conduct classroom activities, homework, quizzes, tests, and assignments. However, out of these 10, only two stated that they use it for formative assessment purposes which is to collect timely feedback and adjust instruction accordingly. The participants' limited knowledge in these aspects influences the low take-up of formative assessment in their classrooms. It is therefore a hindrance to achieving the ultimate benefit of formative assessment practice.

As such, a tailored professional development (PD) program was developed to focus on what constitutes formative assessment and how it is effectively applied in higher education classrooms with applicable technologies. The results obtained from the interviews revealed information that served as the foundation for the content of the PD program. The PD program was designed to address these concerns and inadequacies in implementing formative assessment practice informed by technologies. The program provided participants with support and guidance to consistently and effectively implement formative assessment practice informed by technologies. Its content made it possible for the participants to take several paths to implement formative assessment and associated technologies in the classroom. For instance, the participants were unable to define formative assessment appropriately and often confused it with summative assessment. That is why the focus of the 1st session of the PD was on the definition of formative assessment, unpacking its main components and benefits as well as highlighting the process of formative assessment. In other words, each session of the PD program was designed based on their needs and areas of improvement as illustrated earlier in **Table 6.3**.

Overall, it is not easy to quantify formative assessment practice, yet it is important to ascertain how much formative assessment is currently being carried out. The interview questions served to get answers in relation to a small unit (English Language Centre) at the University of Technology and Applied Sciences (UTAS-Ibri).

Although a convenience sample of lecturers from one university was used, it is hoped that this interview instrument will serve as a basis for universities to determine the uptake of formative assessment and how technology can consolidate it. However, to elicit more nuanced data, the interview questions could be improved by asking more specific and probing questions about the use of formative assessment. The questions could explicitly ask about the frequency, strategies, mode, impact, benefits, and barriers of using technology-based formative assessment.

A questionnaire could be created with more specific and structured questions to be used by higher education institutions to determine how much formative assessment informed by technologies is being used. With a questionnaire instead of an interview, higher education institution personnel could collect more standardised, reliable, and generalisable data from a larger and more representative sample of lecturers from all disciplines and levels of experience. This would generate more actionable insights and further suggestions for implementing formative assessment and associated technologies effectively.

A general conclusion that can be made is that the participants had limited understanding of formative assessment, its purposes, its pedagogical practices, and technological content knowledge. There was a variation in how much formative assessment is currently carried out by English language lecturers at UTAS-Ibri, from hardly anything to a good deal. The next section explores the third research question of the thesis.

8.4 Research Question 3: How well do English language lecturers in a higher education institution in Oman apply and practice formative assessment informed by technologies?

One of the key points stressed in this thesis is that when assessing lecturers' usage of formative assessment and associated technologies, their assessment tasks should provide evidence which enables to locate them on the measurement rubric. Therefore, using a Classroom Observation Protocol that applied the measurement rubric (Appendix M) during the classroom observations provided an answer of how well English language lecturers at the University of Technology and Social Sciences (UTAS-Ibri) apply formative assessment. It enabled them to be located (or to locate themselves) on it based on the evidence collected to demonstrate what it is they know and can do. This included their ability to use associated technologies to create and deliver tasks and activities that improved instruction.

A key finding from classroom observation is that participants, prior to receiving the professional development (PD) program, did poorly except one (Table 6.2). They were at the lower levels because their classroom performance barely showed any supporting evidence for effective formative assessment practice informed by technologies. For instance, P05 and P10 were mostly located at either Level 1 (Beginning) or Level 2 (Developing) in all components of the measurement rubric as shown in Table 8.3.

Table 8.3

Participants' 05 and 10 Locations on The Measurement Rubric

FA Component	P05	P10
	Level of Proficiency	
Eliciting and interpreting evidence of student learning	1	1
Providing feedback that moves learning forward	2	2

Providing opportunities for self-assessment	2	0
Creating collaborative culture of learning	1	1
Using evidence to adjust instruction	1	1
Using technology-based assessment	2	0
Mean Score	1.5	0.8

An analysis of their formative assessment classroom practice showed that they made minimal attempts to analyse and review students' responses and thus few instructional adjustments were observed. In other words, the participants collected evidence about student learning during the lesson using certain activities. However, the data were not used to inform instruction nor to help students understand what they know and can do. Furthermore, the feedback provided to their students lacked proper guidance on how to improve work. In this case, their students will tend to show the same evidence of understanding without making progress.

It became evident during the classroom observation that the participants of this study were able to some extent to identify and pinpoint their students' learning needs, but often they did not address these learning needs. The tasks and activities used by participants were ineffectively mediated and thus can prevent students from attaining the desired learning goals. It could be that they do not recognise the activities they used as components of formative assessment, and therefore miss opportunities to maximise the formative impact of the classroom activities. They also made the least use of technology to support formative assessment, particularly Participant 10 who used it as a platform to conduct online classes and present course content. His use of technology was limited to the delivery of teaching

materials, due to COVID-19 restrictions. Ineffective use of technology precluded lecturers from understanding students' needs and therefore constrained lecturers' formative assessment practice.

Participant 05 used technology for formative assessment purposes but on a limited basis during a warm-up activity. Besides, her focus was on stating the right and wrong answers and then she moved on to the next thing that had to be completed. Her practice indicated that she hardly played any role in identifying the students' weaknesses when utilising technology. The lecturer's use of formative assessment in this case can be described as product driven rather than process oriented. Formative assessment is not about presenting information or providing grades. Formative assessment is about collecting evidence of student learning and using it to inform instruction. Technology in turn plays a vital role in helping lecturers implement formative assessment more effectively and efficiently, but only if they use it with a clear purpose. Hence, the findings here showed that participants' insufficient practice could be attributed to the concerns that they lacked the foundational knowledge and skills of formative assessment practice informed by technologies.

Overall, the participants' limited understanding of formative assessment served as a barrier if not hinderance to their implementation of formative assessment practice and associated technologies. They did not put most of the formative assessment cycle activities into practice. In other words, they still require further development to effectively achieve the full benefits of formative assessment and associated technologies. The participants were unable to used technology to get a comprehensive image of student understanding and thus they were unable to successfully determine what instructional adjustments, if any, were needed to meet students' learning goals.

The measurement rubric addresses the question of how well lecturers can deploy formative assessment and associated technologies. However, some limitations and challenges

should be taken into account, such as the subjectivity of the rater, the time and resources required for referencing evidence against the measurement rubric and other factors that may dictate lecturers' practice. Another important point to consider is that technology in the measurement rubric is an independent component. This implies that the measurement rubric could be applied to measure the effectiveness of formative assessment practice without reference to technology.

The next section addresses the fourth and the last research question posed in this thesis.

8.5 Research Question 4: To what extent do lecturers who have undertaken a Professional development program targeting Technology-based Formative Assessment (TBFA) improve in their understanding and practice of using TBFA in the classroom?

The professional development (PD) program was followed by the implementation phase in which the participants had the opportunity to implement what they gained from the PD program in their classroom practices and measure the effectiveness of their practice using the measurement rubric. Toward the end of the study, Stage 4, further classroom observations and interviews were conducted in conjunction with the measurement rubric to examine the extent to which the PD program impacted the participants' usage of formative assessment and associated technologies.

A key question that has driven this thesis is to know "How can we tell if PD has changed anything and what are the improvements it has caused?" The literature suggested there was a lack of empirical research on the effectiveness of professional development programs in formative assessment practice (Anderson & Palm, 2017). Hence, a clear gain from using interviews and classroom observations as evaluative methods for measuring the impact of the PD helped to develop thinking about what effective PD is, how to achieve it,

and how to evaluate the impact of any activity. In other words, this thesis has attempted to provide not only a professional development program, but also a method to measure what effect professional development programs have on lecturers' formative assessment practice informed by technologies.

In terms of changes in participants' understanding, the interview data revealed a tangible difference to their understanding when compared to the interviews conducted prior to receiving the PD program. This was interpreted from the way they responded to the interview questions (Appendix L). The participants also acknowledged that their use of the measurement rubric directed their attention to identifying their strengths and weaknesses during the implementation phase. They were able to compare their classroom practices with the measurement rubric to self-evaluate themselves using the predefined proficiency levels. The ability to locate themselves on proficiency levels quantified by the measurement rubric showed how well they demonstrated the knowledge and skills needed.

During the interviews, they shared how the PD program enabled them to learn more about formative assessment and how they integrated technology to collect timely data, analyse evidence of student learning and adjust instruction accordingly. There was some impact on their formative assessment practices, their understanding of its purposes, and the peculiarities of its application in the teaching and learning process which was discussed during the PD program. For example, the participants' responses like "I came to know many new ideas starting from the definition of the formative assessment and then I came to know the whole process of formative assessment practice" (P06), "PD sessions were more a free crash course on formative assessment" (P04), and "knowing the theory is really good but what's really important is to apply those theories in a real-world context" (P11), are interpreted as how the PD's content provided them with actionable classroom strategies. The PD program exhibited a logical flow of formative assessment process and associated

technologies integrated with wide ranges of activities tailored according to participants' needs, discussions, and reflection.

In terms of the impact of the PD on their classroom work, observations of eight classes provided a way to measure its effect on classroom practice. The findings of the observations revealed that participants did grow in terms of implementing the cycle of formative assessment practice informed by technologies. It is worth noting here that those who were observed prior to the PD phase (Stage 2) of classroom observations (Participants 04, 05, 10 and 11) showed progress in all rated components and thus their mean scores are higher as shown in Table 8.4. The exception was Participant 10.

Table 8. 4

Comparison of the Participants' Mean Scores Pre-and Post-PD Phase

	Participant/Mean Score/4			
	P04	P05	P10	P11
Pre-PD Phase (Classroom Observation #1)	3	1.5	0.8	1.6
Post-PD Phase (Classroom Observation #2)	3.6	3	0.8	3.1

The observational data demonstrated no visible improvement in Participant 10's formative assessment practice, although he attended all the sessions of the PD program. Some guidance was given to him during a post-observation feedback discussion.

For example, in terms of using technology to support formative assessment practice, Participant 10, who remained at Level 0, found it difficult to implement formative assessment using technologies for several reasons, including a heavy workload, time constraints, lack of students' engagement and poor internet connection as stated during the interview. A possible explanation may be that the lecturers are forced to adhere rigidly to the pacing of the

curriculum. They are pressurised to complete the assigned content and its associated assessment tasks (e.g, quizzes, assignments, midterm examination) within allocated timeframe and therefore find it difficult to effectively implement formative assessment practice informed by technologies.

Finally, the participants' reflections were favourably inclined to support the professional development program. Those who attended the PD program did experience a positive change in their understanding regarding the use of formative assessment and associated technologies; their classroom practices improved too. Based on this, it is recommended to provide a tailored professional development program based on lecturers' needs as a basic prerequisite for effective implementation of formative assessment and associated technologies. It is important that lecturers' voices are heard and their needs are taken into consideration. Several other studies provide a level of confidence in the evidence suggesting that professional development programs could greatly advance formative assessment practice (Andersson & Palm, 2017; Cisterna & Gotwals, 2018; Furtak et al., 2016; Kintz, Lane, Gotwals, & Cisterna, 2015; Randel, Apthorp, Beesley, Clark, & Wang, 2016, as cited in Kenyon, 2019).

However, a key limitation was the short duration of the program and the subsequent implementation period. Moreover, there has been no attempt in this study to determine the sustainability of the PD program. To sustain and enhance their learning, lecturers need ongoing support for implementing formative assessment practice informed by technologies. For example, they need to be involved in professional development communities (PLCs), which provide opportunities to reflect and give feedback on formative assessment and implementation practices (Kenyon, 2019). Consequently, further experimental studies could be conducted to determine the effectiveness of professional development programs in improving lecturers' understanding and execution of technology-based formative assessment.

8.6 Implications of the Thesis

The findings presented in this thesis are very valuable and will assist reforms that are taking place in higher education. The results are of particular significance for: designers of curricula, pedagogy, assessment, and testing; lecturers; professional development trainers and policymakers involved in higher education in Oman and elsewhere. This thesis contributes to the literature by providing information which can lead to the consistent and effective implementation of formative assessment practice informed by technologies. The initial interview and classroom observations provided insights into how lecturers in Oman perceive and practice formative assessment. It draws attention to their limited understandings of formative assessment, noting that it restricted them in fully utilising the formative assessment strategies and associated technologies as part of their duties.

This thesis contributes to the literature on technology-based formative assessment (TBFA) by developing a process for devising and validating a new measurement tool (measurement rubric) to measure lecturers' effectiveness of formative assessment practice informed by technologies. Additionally, the tailored professional development (PD) presented a program where the content was informed by data collected from interviews and the classroom observations. Furthermore, examining the impact of the PD program on formative classroom practice, made it possible to empirically link the formative assessment practice used in the classroom to improved understanding of the practice and associated technologies. Not enough studies have directly addressed the issue of changing teaching practice because the processes have not been well understood (Timperley et al., 2007, as cited in Andersson, 2015). Hence, higher education institutions can benefit from this thesis outcomes as it can help bridge the gap between lecturers' current understanding and practice of formative assessment informed by technologies. By using the measurement rubric

developed in this thesis, it is now possible to provide supporting evidence of how effectively lecturers are practicing formative assessment.

Practically, this thesis provides insights into the current state of formative assessment practice and associated technologies in a university in Oman, as well as the challenges and opportunities for enhancing it. Although there were some limitations, this thesis provides a basis for further exploration of technology-based formative assessment in higher education contexts. For formative assessment to be utilised to its full potential, lecturers must understand it as an ongoing process and distinct from summative assessment. It may also be an advantage for all higher educational institutions to understand lecturers' needs and create dynamic targeted initiatives, including but not limited to, professional development programs that will meet the needs of the 21st century workplace and university courses. Such support will not only assist lecturers with the guidance they need to implement technology-based formative assessment practice but also will shape the quality of classroom instruction and the learning environment in general.

8.7 Limitation of the Thesis

One major limiting factor of the current thesis is that the research was restricted to one institution of higher education in Oman. One of the primary reasons for this was that because of accessibility issues associated with COVID-19, and the logistics of working intensely in more than one institution made it impossible to expand the sample size. Taking this limitation on board means that the study is really demonstrating a method, a proof-of-concept and the results cannot be extended beyond the unit discussed here. Other higher education institutions may vary in terms of curricula, teaching methods, assessment methods, and administrative facilities. Moreover, the study was limited to participants from the same academic field. This again limits its generalisability. In identifying this as a weakness, it is important to reiterate that there was never an attempt to choose a sample for involvement in

this study that would enable generalisability beyond the lecturers who participated. However, the measurement rubric could be used with representative samples to answer the question regarding the impact of the PD across a broader and better-defined population, that would be designed to address questions related to the impact of lecturers who drop-out of the study as part of the design of the study. This study is demonstrating how lecturers can be assessed and located on the measurement rubric even when the assessments are not standardised. While having a convenience sample is a limitation of the study if the intention is to evaluate the effectiveness of the PD, it is not a limitation when the purpose is to build and validate a measurement rubric and demonstrate its use.

Because of the limitations in logistics and participation, the generalisability of the evidence reported here and based on the measurement rubric is restricted. In addition, the focus group brought together six participants from the same academic field with no requirement to have expertise in the educational assessment and measurement field. If this study were repeated beyond this proof-of-concept study, then it would be worthwhile setting more challenging criteria for the focus group. It is therefore strongly advised to include experts from branches of knowledge, academic fields and expertise that are not covered in this study, as this would certainly strengthen the level of validity.

Moreover, the validation process could be extended to include statistical validation of the protocols and interview instruments that have been used in this study. Put simply, the results revealed here might not hold in a broader context with a more diverse set of participants and, as such, need to be replicated, but the process of developing the measurement rubric is generalisable.

Another limiting factor is that the effects measured were short-term ones. Sustainability of the outcomes is essential to support the validation argument of the professional development (PD) program and the measurement rubric. It is therefore

recommended to provide evidence that the desired outcomes are sustainable over time and can be measured.

In light of what is both feasible and sound, the integration of technology appeared effective in engaging students and promoting formative assessment practice. However, this thesis did not examine the potential impact of effective implementation of formative assessment practice and associated technologies on students' learning. Additionally, the use of technological tools was limited to student response system (SRS) and the other available resources at MS Teams. This limited technology focus could lead to overlooking other invaluable tools or instructional strategies. The emergence of Artificial Intelligence (AI) shows promise – despite the controversy surrounding it – in the realm of formative assessment. For instance, the use of conversational agents (also called chatbots) can create interactive learning experience through collecting data on students' learning and provide personalised feedback to them. Open AI's ChatGPT has shown impressive performance on a variety of tasks, including human-like testing, text summarising, and answering questions in a conversational format (Yildirim-Erbasli & Bulut, 2023). It can be utilised to devise formative assessment prompts (Zhai, 2023). Therefore, the use of technology goes beyond the types used in this thesis. Studies on integrating other innovative tools like ChatGPT and other software applications that use artificial intelligence (AI-powered apps), virtual reality (VR), augmented reality (AR) are important, so that lecturers can seamlessly integrate various tools into formative assessment practice.

8.9 Directions for Future Research

Notwithstanding the limitations, this thesis makes a vital contribution to understanding of formative assessment and how it can be supported. This thesis was aimed at understanding current knowledge and practice of formative assessment informed by technologies as well as the changes in lecturers' understanding and practice after receiving a

tailored professional development (PD) program. It was beyond the scope of this thesis to investigate the factors limiting the effectiveness of formative assessment practice in higher education. There is a need to address the issues that hinder the effective practice of formative assessment in higher education courses. Hence, further research to look at those factors would make valuable contributions to the topic of formative assessment.

The findings presented here suggested that professional development can improve lecturers' effectiveness in practising formative assessment that is informed by technologies in the short-term. These findings are consistent with previously made claims about the impact of professional development in changing teaching practice. Based on the findings of this thesis and knowing its several limitations, it is of great importance, to investigate the understanding and practice of lecturers' formative assessment in other higher education contexts with a greater and more systematically constituted sample so that the results could be generalisable in a larger context.

There are several avenues to explore in more detail in future research. One avenue comprises the components for technology-based formative assessment that are not highlighted in the measurement rubric of this thesis. For instance, identifying learning goals and criteria for success could be viewed as an independent component. This would make a further contribution to the field of using the rubric to measure lecturers' formative assessment practice. Future research plans with the measurement rubric include examining its effect as a guide to improve lecturers' technology-based formative assessment tasks in higher education are highly recommended.

8.10 Concluding Remarks

In this era of technology and increased accountability of lecturers in higher education institutions, careful attention must be paid to the assessment and the integration of technology. Although formative assessment has emerged as a viable practice to improve

teaching and learning processes, there is currently a low take-up of formative assessment in higher education.

This thesis used a mixed methods approach to investigate the current understanding and practice of formative assessment and associated technologies that is being carried out in the English Language Centre (ELC) at the University of Technology and Applied Sciences (UTAS-Ibri), Oman. Further, a measurement rubric was created and validated to ascertain the effectiveness of formative assessment practice informed by technologies, and to monitor any changes after participating in a professional development (PD) program.

The findings revealed that the participants initially had limited understanding and inconsistent practice of formative assessment and associated technologies. Interestingly, they showed an improvement in their understanding and the classroom practice as well as the way they integrate technology with their work after the PD program.

This study adds to existing research regarding the effective and consistent implementation of technology-based formative assessment in higher education courses, in Oman and more internationally. A major contribution is that a measurement rubric can assess the effectiveness of formative assessment practice and associated technologies. It provides evidence-based decisions of what lecturers know and can do. Another contribution comes from the empirical evidence on the impact of the developed PD on lecturers' understanding and practice of formative assessment and associated technologies. The professional development (PD) program provides structured guidance and practical tools that can help lecturers improve their formative practice linked to associated technologies.

This thesis also demonstrates a need for further research into the field of formative assessment when enhanced by technologies. Additionally, efforts should be made to further maximise the validation of the measurement rubric, interview instruments, and the PD program as well as measure their sustainability effects. Furthermore, steps can be taken to

sensitise all higher education institutions, professional development providers, and policymakers on the importance of empowering lecturers with instructional support to effectively implement formative assessment practice. It is imperative, therefore, that further large-scale studies be undertaken to determine how the measurement rubric and the professional development program can enhance lecturers' technology-based formative assessment practice in the courses they teach.

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Appendices

Appendix A: The University of Sydney Approval



Research Integrity & Ethics Administration HUMAN RESEARCH ETHICS COMMITTEE

Wednesday, 2 June 2021

Mr James Tognolini
Social Work; Faculty of Arts and Social Sciences
Email: james.tognolini@sydney.edu.au

Dear James,

The University of Sydney Human Research Ethics Committee (HREC) has considered your application.

I am pleased to inform you that after consideration of your response, your project has been approved.

Details of the approval are as follows:

Project No.: 2021/243
Project Title: Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses
Authorised Personnel: Tognolini James; Mantai Lilia; Al Alawi Rahma;
Approval Period: 02/06/2021 to 02/06/2025
First Annual Report Due: 02/06/2022

Documents Approved:

Date Uploaded	Version Number	Document Name
28/05/2021	Version 1	PCF_For Students_Class Observation
28/05/2021	Version 1	PIS_For Students_Class Observation
20/03/2021	Version 1	Email Permission for Rubric Validation
20/03/2021	Version 1	Email Permission for PD, interviews and class observations
20/03/2021	Version 1	PIS_PD_Interview_Class observation
20/03/2021	Version 1	PIS_Rubric Validation
22/02/2021	Version 1	Invitation Email 1
22/02/2021	Version 1	Invitation Email 2
22/02/2021	Version 1	PCF_interview
22/02/2021	Version 1	PCF_Class Observation
22/02/2021	Version 1	Interview Questions_Focus Group 1
22/02/2021	Version 1	Interview Questions_Focus Group 2
22/02/2021	Version 1	Safety Protocol

Condition/s of Approval

- Research must be conducted according to the approved proposal.
- An annual progress report must be submitted to the Ethics Office on or before the anniversary of approval and on completion of the project.

Research Integrity & Ethics Administration
Research Portfolio
Level 3, F23 Administration Building
The University of Sydney
NSW 2006 Australia

T +61 2 9036 9161
E human.ethics@sydney.edu.au
W sydney.edu.au/ethics

ABN 15 211 513 404
CRICOS 00026A



- You must report as soon as practicable anything that might warrant review of ethical approval of the project including:
 - Serious or unexpected adverse events (which should be reported within 72 hours).
 - Unforeseen events that might affect continued ethical acceptability of the project.
- Any changes to the proposal must be approved prior to their implementation (except where an amendment is undertaken to eliminate *immediate* risk to participants).
- Personnel working on this project must be sufficiently qualified by education, training and experience for their role, or adequately supervised. Changes to personnel must be reported and approved.
- Personnel must disclose any actual or potential conflicts of interest, including any financial or other interest or affiliation, as relevant to this project.
- Data and primary materials must be retained and stored in accordance with the relevant legislation and University guidelines.
- Ethics approval is dependent upon ongoing compliance of the research with the *National Statement on Ethical Conduct in Human Research*, the *Australian Code for the Responsible Conduct of Research*, applicable legal requirements, and with University policies, procedures and governance requirements.
- The Ethics Office may conduct audits on approved projects.
- The Chief Investigator has ultimate responsibility for the conduct of the research and is responsible for ensuring all others involved will conduct the research in accordance with the above.

This letter constitutes ethical approval only.

Please contact the Ethics Office should you require further information or clarification.

Sincerely,

Associate Professor Mark Arnold
Chair, Human Research Ethics Committee (HREC 2)

The University of Sydney of Sydney HRECs are constituted and operate in accordance with the National Health and Medical Research Council's (NHMRC) [National Statement on Ethical Conduct in Human Research \(2018\)](#) and the NHMRC's [Australian Code for the Responsible Conduct of Research \(2018\)](#)

Appendix B: Oman's University of Technology and Applied Sciences Approval

Sultanate of Oman
University of Technology and Applied Sciences



سلطنة عُمان
جامعة العلوم والتكنولوجيا التطبيقية

No. 115113/2021
DATE: 4-12-1442
DATE: 14-07-2021

الرقم: ٤-١ / ١١٥١١٣
التاريخ: ٤-١٢-١٤٤٢
الموافق: ١٤-٧-٢٠٢١

Respected Deans of University of Technology and Applied Sciences (CoTs) المحترمين
الأفاضل/ عمداء الكليات التقنية بجامعة العلوم والتكنولوجيا التطبيقية

After greetings,

السلام عليكم ورحمة الله وبركاته وبعد،،،

Subject: Facilitating Research Task

الموضوع: تسهيل مهمة باحث

This is to certify that we have no objection in allowing Mrs. Rahma Awadh Mattar Al Alawi to pursue the field application of his research:

يرجى التكرم بالعلم بأنه لا مانع لدينا من إجراء الباحث/ رحمة عوض مطر العلوي للبحث الميداني لدراسته العلمية عن:

Developing a comprehensive Framework to enhance technology based formative assessment practice in higher education courses

تطوير إطار شامل لتحسين عملية التقييم الإلكتروني في مساقات التعليم العالي

In order to fulfill the requirements of attaining (PhD) in education from University of Sydney, Australia.

حسب الجدول المرفق (١)، وذلك استكمالاً لمتطلبات نيل شهادة الدكتوراه من جامعة سيدني في أستراليا.

We kindly ask you to provide all the required facilities that the researcher needs through filling in the required information at the following information (attached table). For more details, please contact the researcher via email: raal5080@uni.sydney.edu.au

أملين منكم التكرم بالإيعاز للمعنيين لديكم تقديم التسهيلات اللازمة التي يحتاج إليها الباحث من خلال تعبئة البيانات المطلوبة. ولمزيد من التفاصيل يرجى التواصل مع الباحث على البريد الإلكتروني التالي: raal5080@uni.sydney.edu.au.

Sincerely,

وتفضلوا بقبول فائق الاحترام والتقدير،،،

Dr. Aflah Zaher Al Shaqsi
Director of Academic affairs



د. أفلح بن زاهر الشقسي
مدير دائرة الشؤون الأكاديمية

Appendix C: Focus Group Invitation Email



School of Education and Social Work

ABN 15 211 513 464

PROFESSOR JIM TOGNOLINI

Director

Educational Measurement and Assessment Hub

Room 333

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The University of Sydney

NSW 2006 AUSTRALIA

Telephone: +61 2 86275205

Email: jim.tognolini@sydney.edu.au

Web: <http://www.sydney.edu.au/>

Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

Invitation email – Reviewing an analytic rubric of technology-based formative assessment (Focus group)

Dear Sir/Madam,

My name is Rahma Al Alawi and I am a PhD candidate at the University of Sydney.

You are invited to participate in a research project entitled "Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses".

The broad aim of this research is to develop a comprehensive framework to enhance technology-based formative assessment practice. This leads to develop a targeted instructional support accompanied with the development of an analytic rubric and a professional development program to guide and enhance lecturers' knowledge and use of formative assessment enhanced by technology.

In this study, you will be required to review a draft of an analytic rubric and take part in a focus group discussion in which you will be asked to discuss your views with other members of the group. The rubric includes the key elements of formative assessment (five dimensions) and the integration of technology to provide a framework to guide and foster lecturers' formative assessment practice.

If you agree to participate in this study, the discussion session will be approximately 4 hours and to be completed in a day. Your participation in this study is completely voluntary and you may withdraw at any time during the study. All information that you provide will remain confidential.

If you have experience in teaching, learning and educational assessment or related skills, and would like to take part in this project, please confirm your participation to the researcher at raal5087@uni.sydney.edu.au.

Thank you,

Rahma Al Alawi

Researcher

School of Education and Social Work

The University of Sydney

Appendix D: Participation in Stages (2-4) Invitation Email



School of Education and Social Work

ABN 15 211 513 464

PROFESSOR JIM TOGNOLINI

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Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

Invitation email – Participation in a professional development program

Dear Sir/Madam,

You are invited to participate in a research project entitled “Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses”.

The broad aim of this research is to develop a comprehensive framework to enhance technology-based formative assessment practice. This leads to develop a targeted instructional support accompanied with the development of an analytic rubric and a professional development program to guide and enhance lecturers’ knowledge and use of formative assessment enhanced by technology.

The data collection procedure involves conducting interviews; at the beginning of the study (pre-interview) and at the end of the study (post-interview), class observations and professional development program.

If you agree to participate in this study, the interview sessions will be approximately 40- 60 minutes. You will be engaged in four professional development sessions. Some classes will be observed prior to conducting the professional development program and after.

Your participation in this study is completely voluntary and you may withdraw at any time during the study. All information that you provide will remain confidential.

If you have experience in teaching, learning, use of technology and educational assessment or related skills, and would like to take part in this project, please confirm your participation to the researcher at raal5087@uni.sydney.edu.au.

Thank you,

Rahma Al Alawi

Researcher

School of Education and Social Work

The University of Sydney

Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

Version 1- 22 Feb 2021

Page 1 of 1

Appendix E: Focus Group Participant Information Statement



School of Education and Social Work

ABN 15 211 513 464

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Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

PARTICIPANT INFORMATION STATEMENT- Focus group (Rubric Validation)

(1) What is this study about?

You are invited to take part in a research study about developing a comprehensive framework to enhance technology-based formative assessment practice. This leads to develop a targeted instructional support accompanied with the development of an analytic rubric and a professional development program to guide and enhance lecturers' knowledge and use of formative assessment enhanced by technology.

You have been invited to participate in this study because of your expertise and experience in assessment field in higher education sector.

This Participant Information Statement tells you about the research study. Knowing what is involved will help you decide if you want to take part in the research. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

By giving your consent to take part in this study you are telling us that you:

- ✓ Understand what you have read.
- ✓ Agree to take part in the research study as outlined below.
- ✓ Agree to the use of your personal information as described.

You will be given a copy of this Participant Information Statement to keep.

(2) Who is running the study?

The study is being carried out by Rahma Al Alawi, PhD Student, Sydney School of Education and Social Work, The University of Sydney.

Rahma Al Alawi is conducting this study as the basis for the degree of PhD at The University of Sydney. This research takes place under the supervision of Professor Jim Tognolini from the Sydney School of Education and Social Work, University of Sydney.

(3) What will the study involve for me?

If you participate in this focus group discussion, you will be invited to be part of a semi-structured interview by answering or responding to open-ended questions provided by the researcher and will be audio recorded. In this study, you will be required to review a draft of an analytic rubric which is developed by the researcher. The developed rubric is designed to measure formative assessment practice enhanced by technology. By taking part in a focus group, you will be asked to discuss your views with other members of the group. The discussion might take place at the English Language Centre or other appropriate venue at the University of Technology and Applied Sciences, Ibri, Oman, where the researcher will ensure that you feel safe or comfortable. Your participation will be anonymous in any references made to the data emerging from the study.

(4) How much of my time will the study take?

The focus group will involve a discussion up to four hours and require a day to be completed. The researcher will ensure that there will be a break within two hours for refreshment (tea break and lunch will be provided).

(5) Who can take part in the study?

The following are the selection criteria of teacher participants in the study:

- (1) professionals who are engaged in higher education sector.
- (2) having more than 5 years of teaching experience in higher education.
- (3) having theoretical and practical knowledge in assessment, instructional design, and technology.
- (4) willing to participate in the study without any enforcement.

(6) Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of Sydney, University of Technology and Applied Sciences, any other individuals, or organisations related to this study.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time. You can do this by contacting the researcher either via direct verbal statements (face-to-face or by phone) or written statements via email. All your responses will be kept and included in this study. All the recordings cannot be deleted due to the group nature of the conversation and the feedback that you have provided will be included in the study results.

If you take part in a focus group, you are free to stop participating at any stage or to refuse to answer any of the questions. However, it will not be possible to withdraw your individual comments from our records once the group has started, as it is a group discussion.

(7) Are there any risks or costs associated with being in the study?

Aside from giving up your time we do not expect that there will be any risks or costs associated with taking part in this study.

(8) Are there any benefits associated with being in the study?

We cannot guarantee that you will receive any direct benefits from being in the study. However, the result of this study might create opportunities for lecturers in Oman (and more broadly) to use targeted instructional support to improve teaching and learning as well as encourage the use of innovative technologies in the formative assessment process.

(9) What will happen to information about me that is collected during the study?

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise.

Your information will be stored securely and your identity/information will be kept strictly confidential, except as required by law. Study findings may be published, but you will not be individually identifiable in these publications.

(10) Can I tell other people about the study?

Yes, you are welcome to tell other people about the study.

(11) What if I would like further information about the study?

When you have read this information, Ms Rahma Al Alawi will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact *Ms Rahma Al Alawi*, student researcher, email: raal5087@uni.sydney.edu.au, telephone: +96892599932 or Professor Jim Tognolini, supervisor, email: jim.tognolini@sydney.edu.au, telephone: +61 2 8627 5205.

(12) Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by *ticking the relevant box on the consent form*. This feedback will be in the form of This feedback will be in the form of a one-page lay summary. You will receive this feedback after the study is finished.

(13) What if I have a complaint or any concerns about the study?

Research involving humans in Australia is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of the University of Sydney [2021/243]. As part of this process, we have agreed to carry out the study according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect people who agree to take part in research studies.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the university using the details outlined below. Please quote the study title and protocol number.

The Manager, Ethics Administration, University of Sydney:

- **Telephone:** +61 2 8627 8176
- **Email:** human.ethics@sydney.edu.au

- **Fax:** +61 2 8627 8177 (Facsimile)

In addition, a local contact for any complaint or concern is provided below:

Dean's office, University of Technology and Applied Sciences (Ibri)

- **Telephone:** +968 25686005
- **Email:** DeanOffice@ibri.ct.edu.om
- **Fax:** +968 25696130

Appendix F: Participant Information Statement (Stages 2-4)



School of Education and Social Work

ABN 15 211 513 464

PROFESSOR JIM TOGNOLINI

Director

Educational Measurement and Assessment Hub

Room 333

Education Building A.35

The University of Sydney

NSW 2006 AUSTRALIA

Telephone: +61 2 86275205

Email: jim.tognolini@sydney.edu.au

Web: <http://www.sydney.edu.au/>

Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

PARTICIPANT INFORMATION STATEMENT- Focus group 2

(1) What is this study about?

You are invited to take part in a research study about developing a comprehensive framework to enhance technology-based formative assessment practice. This leads to develop a targeted instructional support accompanied with the development of an analytic rubric and a professional development program to guide and enhance lecturers' knowledge and use of formative assessment enhanced by technology.

You have been invited to participate in this study because of your expertise and experience in the use of technology and teaching in higher education sector.

This Participant Information Statement tells you about the research study. Knowing what is involved will help you decide if you want to take part in the research. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

By giving your consent to take part in this study you are telling us that you:

- ✓ Understand what you have read.
- ✓ Agree to take part in the research study as outlined below.
- ✓ Agree to the use of your personal information as described.

You will be given a copy of this Participant Information Statement to keep.

(2) Who is running the study?

The study is being carried out by Rahma Al Alawi, PhD Student, Sydney School of Education and Social Work, The University of Sydney.

Rahma Al Alawi is conducting this study as the basis for the degree of PhD at The University of Sydney. This research takes place under the supervision of Professor Jim Tognolini from the Sydney School of Education and Social Work, University of Sydney.

(3) What will the study involve for me?

If you choose to be a part of this study, you will be interviewed on two occasions for about an hour each time, and between the interviews, on two occasions, I will observe your classes. After the first interview you will attend professional development program developed by the researcher. The interviews will be audio-recorded, whereas the observations will be recorded video recorded. I will take notes in both the interviews and the observations.

The interviews and observations will take place at the English Language Centre or other appropriate venue at the University of Technology and Applied Sciences, Ibri, Oman, where the researcher will ensure that you feel safe or comfortable. Your participation will be anonymous in any references made to the data emerging from the study.

(4) How much of my time will the study take?

Your participation will involve two interviews (pre- and post- interview) of an hour each, and two classroom observations of over the course of two to three months. As for the professional development program you will be engaged in four professional development sessions that specifically focus on learning and applying the five core dimensions of formative assessment from the developed rubric. The duration of each session will be 150 minutes including a break for refreshments.

(5) Who can take part in the study?

The following are the selection criteria of teacher participants in the study:

- (1) having more than 5 years of teaching experience in higher education
- (2) having experience in the use of technology
- (3) willing to participate in the study without any enforcement

(6) Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of Sydney, University of Technology and Applied Sciences, any other individuals, or organisations related to this study.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time. You can do this by contacting the researcher either via direct verbal statements (face-to-face or by phone) or written statements via email. All your responses will be kept and included in this study. All the recordings cannot be deleted due to the group nature of the conversation and the feedback that you have provided will be included in the study results.

If you take part in a focus group, you are free to stop participating at any stage or to refuse to answer any of the questions. However, it will not be possible to withdraw your individual comments from our records once the group has started, as it is a group discussion.

(7) Are there any risks or costs associated with being in the study?

Aside from giving up your time we do not expect that there will be any risks or costs associated with taking part in this study.

(8) Are there any benefits associated with being in the study?

We cannot guarantee that you will receive any direct benefits from being in the study. However, the result of this study might create opportunities for lecturers in Oman (and more broadly) to use targeted instructional support to improve teaching and learning as well as encourage the use of innovative technologies in the formative assessment process.

(9) What will happen to information about me that is collected during the study?

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise.

Your information will be stored securely and your identity/information will be kept strictly confidential, except as required by law. Study findings may be published, but you will not be individually identifiable in these publications.

(10) Can I tell other people about the study?

Yes, you are welcome to tell other people about the study.

(11) What if I would like further information about the study?

When you have read this information, Ms Rahma Al Alawi will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact *Ms Rahma Al Alawi*, student researcher, email: raal5087@uni.sydney.edu.au, telephone: +96892599932 or Professor Jim Tognolini, supervisor, email: jim.tognolini@sydney.edu.au, telephone: +61 2 8627 5205.

(12) Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by *ticking the relevant box on the consent form*. This feedback will be in the form of This feedback will be in the form of a one-page lay summary. You will receive this feedback after the study is finished.

(13) What if I have a complaint or any concerns about the study?

Research involving humans in Australia is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of the University of Sydney [2021/243]. As part of this process, we have agreed to carry out the study according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect people who agree to take part in research studies.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the university using the details outlined below. Please quote the study title and protocol number.

The Manager, Ethics Administration, University of Sydney:

- **Telephone:** +61 2 8627 8176
- **Email:** human.ethics@sydney.edu.au
- **Fax:** +61 2 8627 8177 (Facsimile)

In addition, a local contact for any complaint or concern is provided below:

Head of English Language Centre, University of Technology and Applied Sciences (Ibri)

- **Telephone:** +968 25686120 / 25686121
- **Email:** Abdulsalam.AIManthari@ibric.edu.om

Appendix G: Participant Consent Form



ABN 15 211 513 464

School of Education and Social Work

PROFESSOR JIM TOGNOLINI
Director
Educational Measurement and Assessment Hub

Room 333
 Education Building A.35
 The University of Sydney
 NSW 2006 AUSTRALIA
 Telephone: +61 2 86275205
 Email: jim.tognolini@sydney.edu.au
 Web: <http://www.sydney.edu.au/>

**Developing a comprehensive framework to enhance technology-based formative assessment practice
 in higher education courses**

PARTICIPANT CONSENT FORM

I,[PRINT NAME], agree to take part in this research study.

In giving my consent I state that:

- I understand the purpose of the study, what I will be asked to do, and any risks/benefits involved.
- I have read the Participant Information Statement and have been able to discuss my involvement in the study with the researchers if I wished to do so.
- The researchers have answered any questions that I had about the study and I am happy with the answers.
- I understand that being in this study is completely voluntary and I do not have to take part. My decision whether to be in the study will not affect my relationship with the researchers or anyone else at the University of Sydney, the University of Technology and Applied Sciences or any other individuals or organisation related to this study, now or in the future.
- I understand that I can withdraw from the study at any time.
- I understand that I may stop the interview at any time if I do not wish to continue, and that unless I indicate otherwise any recordings will then be erased and the information provided will not be included in the study. I also understand that I may refuse to answer any questions I don't wish to answer.

- I understand that I may leave the focus group at any time if I do not wish to continue. I also understand that it will not be possible to withdraw my comments once the group has started as it is a group discussion.
- I understand that personal information about me that is collected over the course of this project will be stored securely and will only be used for purposes that I have agreed to. I understand that information about me will only be told to others with my permission, except as required by law.
- I understand that the results of this study may be published, but these publications will not contain my name or any identifiable information about me.

I consent to:

• **Audio-recording** YES ☐ NO ☐

• **Video-recording** YES ☐ NO ☐

I would like to review my interview transcripts YES ☐ NO ☐

I would like to receive feedback about the overall results of this study YES ☐ NO ☐

If you answered **YES**, please indicate your preferred form of feedback and address:

☐ Postal: _____

☐ Email: _____

.....
Signature

.....
PRINT name

.....
Date

Appendix H: Student Participant Information Statement



School of Education and Social Work

ABN 15 211 513 464

PROFESSOR JIM TOGNOLINI

Director

Educational Measurement and Assessment Hub

Room 333

Education Building A.35

The University of Sydney

NSW 2006 AUSTRALIA

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Web: <http://www.sydney.edu.au/>

Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

PARTICIPANT INFORMATION STATEMENT (For Students)

(1) What is this study about?

You are invited to take part in a research study about developing a comprehensive framework to enhance technology-based formative assessment practice. This leads to develop a targeted instructional support accompanied with the development of an analytic rubric and a professional development program to guide and enhance lecturers' knowledge and use of formative assessment enhanced by technology.

You have been invited to participate in this study because of your position as a student enrolled in the English Language Centre at the University of Technology and Applied Sciences, Oman.

This Participant Information Statement tells you about the research study. Knowing what is involved will help you decide if you want to take part in the research. Please read this sheet carefully and ask questions about anything that you don't understand or want to know more about.

Participation in this research study is voluntary.

By giving your consent to take part in this study you are telling us that you:

- ✓ Understand what you have read.
- ✓ Agree to take part in the research study as outlined below.
- ✓ Agree to the use of your personal information as described.

You will be given a copy of this Participant Information Statement to keep.

(2) Who is running the study?

The study is being carried out by Rahma Al Alawi, PhD Student, Sydney School of Education and Social Work, The University of Sydney.

Rahma Al Alawi is conducting this study as the basis for the degree of PhD at The University of Sydney. This research takes place under the supervision of Professor Jim Tognolini from the Sydney School of Education and Social Work, University of Sydney.

(3) What will the study involve for me?

If you participate in an overt observation taking place at classroom for one teaching hours in flexibly from 60-90 minutes, your activities maybe observed by the researcher with your permission, some of your activities might be recorded through field notes, audio recording and video recording.

(4) How much of my time will the study take?

Approximately 60 -90 minutes.

(5) Do I have to be in the study? Can I withdraw from the study once I've started?

Being in this study is completely voluntary and you do not have to take part. Your decision whether to participate will not affect your current or future relationship with the researchers or anyone else at the University of Sydney, University of Technology and Applied Sciences, any other individuals, or organisations related to this study.

If you decide to take part in the study and then change your mind later, you are free to withdraw at any time. You can do this by contacting the researcher either via direct verbal statements (face-to-face or by phone) or written statements via email. All your responses will be kept and included in this study. All the recordings cannot be deleted due to the group nature of the conversation and the feedback that you have provided will be included in the study results.

If you take part in a classroom observation, you are free to stop participating at any stage. However, it will not be possible to withdraw your individual comments or interactions from our records once the specific session has started as it is a collaborative group process.

(6) Are there any risks or costs associated with being in the study?

Aside from giving up your time we do not expect that there will be any risks or costs associated with taking part in this study.

(7) Are there any benefits associated with being in the study?

We cannot guarantee that you will receive any direct benefits from being in the study.

(8) What will happen to information about me that is collected during the study?

By providing your consent, you are agreeing to us collecting personal information about you for the purposes of this research study. Your information will only be used for the purposes outlined in this Participant Information Statement, unless you consent otherwise.

Your information will be stored securely and your identity/information will be kept strictly confidential, except as required by law. Study findings may be published, but you will not be individually identifiable in these publications.

(9) Can I tell other people about the study?

Yes, you are welcome to tell other people about the study.

(10) What if I would like further information about the study?

When you have read this information, Ms Rahma Al Alawi will be available to discuss it with you further and answer any questions you may have. If you would like to know more at any stage during the study, please feel free to contact *Ms Rahma Al Alawi*, student researcher, email: raal5087@uni.sydney.edu.au, telephone: +96892599932 or Professor Jim Tognolini, supervisor, email: jim.tognolini@sydney.edu.au, telephone: +61 2 8627 5205.

(11) Will I be told the results of the study?

You have a right to receive feedback about the overall results of this study. You can tell us that you wish to receive feedback by *ticking the relevant box on the consent form*. This feedback will be in the form of This feedback will be in the form of a one-page lay summary. You will receive this feedback after the study is finished.

(12) What if I have a complaint or any concerns about the study?

Research involving humans in Australia is reviewed by an independent group of people called a Human Research Ethics Committee (HREC). The ethical aspects of this study have been approved by the HREC of the University of Sydney [*INSERT protocol number once approval is obtained*]. As part of this process, we have agreed to carry out the study according to the *National Statement on Ethical Conduct in Human Research (2007)*. This statement has been developed to protect people who agree to take part in research studies.

If you are concerned about the way this study is being conducted or you wish to make a complaint to someone independent from the study, please contact the university using the details outlined below. Please quote the study title and protocol number.

The Manager, Ethics Administration, University of Sydney:

- **Telephone:** +61 2 8627 8176
- **Email:** human.ethics@sydney.edu.au
- **Fax:** +61 2 8627 8177 (Facsimile)

In addition, a local contact for any complaint or concern is provided below:

Dean's office, University of Technology and Applied Sciences (Ibri)

- **Telephone:** +968 25686005
- **Email:** DeanOffice@ibri.ct.edu.om
- **Fax:** +968 25696130

Appendix I: Student Consent Form



ABN 15 211 513 464

School of Education and Social Work

PROFESSOR JIM TOGNOLINI

Director

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Room 333

Education Building A.35

The University of Sydney

NSW 2006 AUSTRALIA

Telephone: +61 2 86275205

Email: jim.tognolini@sydney.edu.au

Web: <http://www.sydney.edu.au/>

**Developing a comprehensive framework to enhance technology-based formative assessment practice
in higher education courses**

PARTICIPANT CONSENT FORM (For Students)

I,[PRINT NAME], agree to take part in this research study.

In giving my consent I state that:

- I understand the purpose of the study, what I will be asked to do, and any risks/benefits involved.
- I have read the Participant Information Statement and have been able to discuss my involvement in the study with the researchers if I wished to do so.
- The researchers have answered any questions that I had about the study and I am happy with the answers.
- I understand that being in this study is completely voluntary and I do not have to take part. My decision whether to be in the study will not affect my relationship with the researchers or anyone else at the University of Sydney, the University of Technology and Applied Sciences or any other individuals or organisation related to this study, now or in the future.
- I understand that I can withdraw from the study at any time.
- I understand that I may stop the interview at any time if I do not wish to continue, and that unless I indicate otherwise any recordings will then be erased and the information provided will not be included in the study. I also understand that I may refuse to answer any questions I don't wish to answer.

Developing a comprehensive framework to enhance technology-based formative assessment practice in higher education courses

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- I understand that I may leave the focus group at any time if I do not wish to continue. I also understand that it will not be possible to withdraw my comments once the group has started as it is a group discussion.
- I understand that personal information about me that is collected over the course of this project will be stored securely and will only be used for purposes that I have agreed to. I understand that information about me will only be told to others with my permission, except as required by law.
- I understand that the results of this study may be published, but these publications will not contain my name or any identifiable information about me.

I consent to:

- **Audio-recording** YES ☐ NO ☐
- **Video-recording** YES ☐ NO ☐

I would like to review my interview transcripts YES ☐ NO ☐

I would like to receive feedback about the overall results of this study YES ☐ NO ☐

If you answered **YES**, please indicate your preferred form of feedback and address:

☐ Postal: _____

☐ Email: _____

.....
Signature

.....
PRINT name

.....
Date

Appendix J: Measurement Rubric Content Validity Protocol

Hello participants. Thank you for volunteering to participate in this focus group session. My name is Rahma Al Alawi and I am currently working to complete my doctoral requirement for the degree of Doctor of Philosophy in Education at University of Sydney titled “Developing a Comprehensive Framework to Enhance Technology-Based Formative Assessment Practice in Higher Education Courses”. To support my dissertation, I am seeking your participation in this study.

The purpose of this study is to develop a measurement rubric that can be applied across different subjects and different levels. Developing the rubric will include the key elements of formative assessment (five components) and the integration of technology to provide a framework to guide and foster lecturers’ formative assessment practice.

I will be recording this discussion. This interview is completely anonymous, and your responses will be confidential. Please answer the questions to the best of your ability. You may stop at any time and are not required to answer all the questions. The duration of this session will be approximately four hours.

Please sign the consent form before we start the session. This also will indicate that you are agreeing to be involved in this study. Please feel free to let me know if you have any questions regarding the consent form.

I would like you to provide your feedback on a draft of a measurement rubric that has been presented to you:

1. What do you think about the components of formative assessment that have been provided in the draft measurement rubric? Do they capture the definition of formative assessment adequately? Are they sufficient?
2. Do you think that the application of technology has been described to show a development progression for that component of the draft measurement rubric?
3. Do the proficiency level descriptors map out an appropriate developmental path for each of the components?
4. Would you like to add any other information that was not addressed in the provided measurement rubric?

End of Session. Thank you for your time and contributions

Appendix K: Interview 1 Protocol

Hello participants. Thank you for volunteering to participate in this focus group session. My name is Rahma Al Alawi and I am currently working to complete my doctoral requirement for the degree of Doctor of Philosophy in Education at University of Sydney titled “Developing a Comprehensive Framework to Enhance Technology-Based Formative Assessment Practice in Higher Education Courses”. To support my dissertation, I am seeking your participation in this study. The purpose of this study is to develop a measurement rubric that can be applied across different subjects and different levels. Developing the rubric will include the key elements of formative assessment (five components) and the integration of technology to provide a framework to guide and foster lecturers’ formative assessment practice.

The purpose of this focus group session is to fine-tune the understanding of the research problem and explore lecturers’ use of formative assessment and associated technologies at the University of Technology and Applied Sciences (UTAS).

I will be recording this discussion. This interview is completely anonymous, and your responses will be confidential. Please answer the questions to the best of your ability. You may stop at any time and are not required to answer all the questions. The duration of this session will be approximately four hours.

Please sign the consent form before we start the session. This also will indicate that you are agreeing to be involved in this study. Please feel free to let me know if you have any questions regarding the consent form.

I will now start the first part of today’s session:

Bibliographical Information:

Tell me about your academic background, years of experience and current job and responsibilities

Interview Questions:

2. How would you define formative assessment?
8. In your opinion, what are the purposes of formative assessment?
9. How are learning goals communicated to students?
10. How do you usually elicit and interpret evidence of student learning?
11. When and how do you provide feedback to your students?
12. Do you adjust your instruction based on feedback from formative assessment? If yes, how?
13. Do you use technology as a tool for formative assessment practice? If yes, how? If no, why not?

End of Session. Thank you for your time and contributions.

Appendix L: Interview 2 Protocol

Hello participants. Thank you for volunteering to participate in this focus group session. My name is Rahma Al Alawi and I am currently working to complete my doctoral requirement for the degree of Doctor of Philosophy in Education at University of Sydney titled “Developing a Comprehensive Framework to Enhance Technology-Based Formative Assessment Practice in Higher Education Courses”. To support my dissertation, I am seeking your participation in this study. The purpose of this study is to develop a measurement rubric that can be applied across different subjects and different levels. Developing the rubric will include the key elements of formative assessment (five components) and the integration of technology to provide a framework to guide and foster lecturers’ formative assessment practice.

The purpose of this focus group session is to examine lecturers’ use of formative assessment and associated technologies at the University of Technology and Applied Sciences (UTAS) after receiving targeted instructional support.

I will be recording this discussion. This interview is completely anonymous, and your responses will be confidential. Please answer the questions to the best of your ability. You may stop at any time and are not required to answer all the questions. The duration of this session will be approximately four hours.

Please sign the consent form before we start the session. This also will indicate that you are agreeing to be involved in this study. Please feel free to let me know if you have any questions regarding the consent form.

Interview Questions:

1. Has your definition, understanding of the purpose and practice of formative assessment changed from the beginning of the study until now?
2. How do the processes of eliciting, interpreting the evidence and adjusting instruction work to close the gap?
3. To what extent can technology used to support formative practice?
4. To what extent can the “tailored” professional development program and applied rubric support you to understand and apply formative assessment practice and associated technologies in the classroom?
5. Have you changed anything about your assessment (e.g., type, format, delivery, etc.) as a result of the profession development sessions (PD) that you attend?
6. In what ways can the PD program and the applied measurement rubric be further improved?

End of Session.

Thank you for your time and contribution

Appendix M: Classroom Observation Protocol

Classroom Observation Protocol

Participant (code): Date of Observation: Delivery Mode: Subject:

No.	FA Component	Level (Tick the appropriate level)					Comments
		0	1	2	3	4	
1.	Eliciting and interpreting evidence of student learning						
2.	Providing feedback that moves learning forward						
3.	Providing opportunities for self-assessment						
4.	Creating collaborative culture of learning						
5.	Using evidence to adjust instruction						
6.	Using technology-based assessment						

Appendix N: Post-Observation Feedback Form

Post-Observation Feedback Form

Participant (code): Date of Observation: Delivery Mode: Subject:

No.	FA Component	Rating (Level) (0-4)	Evidence
1.	Eliciting and interpreting evidence of student learning		
2.	Providing feedback that moves learning forward		
3.	Providing opportunities for self-assessment		
4.	Creating collaborative culture of learning		
5.	Using evidence to adjust instruction		
6.	Using technology-based assessment		

Overall Comments:

Appendix O: Classroom Observation Field Notes

Participant (code): Date of Observation: Delivery Mode: Subject:

Activities aimed at clarifying where the learner is going	Activities aimed at eliciting where the learner is right now	Providing feedback & adjusted activities	Classroom Culture	The use of technology

Overall comments:

Appendix P: Agenda Professional Development Program

AGENDA

Session 1: Where are we going?

Date: 28/10/2021

Time: 10:00-12:00

Venue: UTAS-Ibri (Meeting Room, ELC)

Time Allotted	Activity
5 minutes	Welcome
5 minutes	The purpose of PD Sessions
	Objectives of today's session
30 minutes	Presentation Part 1 • Definition of FA (based on the initial-interview) • Definition of FA in literature • Definition of FA used in the study • Formative Assessment vs Summative Assessment • Benefits of FA • Activity 1
15 minutes	Presentation: Part 2 • Key components of FA • The Process of FA
15 minutes	Break (Refreshments)
30 minutes	Presentation: Part 3 • Learning goals and criteria for success • Identifying Learning goals and criteria for success • KUD & Bloom's Taxonomy to write effective learning objectives • Sharing and Communicating learning goals and criteria for success • Activity 2 (group work)
10 minutes	Videos: Unpacking Learning Targets
10 minutes	Closing Remarks & Questions

120 minutes

AGENDA

Session 2: Where are we now? Identifying gaps in student learning

Date: 2/11/2021

Time: 12:00-2:00

Venue: UTAS-Ibri (Meeting Room, ELC)

Time Allotted	Activity
5 minutes	Welcome & Recap of the last session Objectives of today's session
5 minutes	Reflection
30 minutes	Presentation: Part 1 • Performance of understanding • Eliciting and interpreting evidence of student learning • Instructional strategies
10 minutes	Discussion
15 minutes	Break (Reflections)
35 minutes	Presentation: Part 2 • What to do after collecting students' responses? • Demo Class
10 minutes	Reflection on Demo Class
10 minutes	Closing Remarks Q & A

120 minutes

AGENDA

Session 3: How to get there?

Date: 3/11/2021

Time: 10:00- 12:00

Venue: UTAS-Ibri (Meeting Room, ELC)

Time Allotted	Activity
5 minutes	Welcome & Recap of the last session Objectives of today's session
30 minutes	Presentation: How to get there? • Closing the gap: Feedback & Instructional adjustments • Feedback Loops • Individualized Descriptive Feedback • Peer Assessment (Peer-review) • Self-Assessment
15 minutes	Activity
15 minutes	Break (Refreshments)
30 minutes	Presentation Part 2: Instructional Adjustments • Scaffolding • Differentiation
15 minutes	Activity
10 minutes	Closing Remarks Q&A

120 minutes

AGENDA

Session 4: Putting it into practice

Date: 4/11/2021

Time: 10:00-12:00

Venue: UTAS-Ibri (Meeting Room, ELC)

Time Allotted	Activity
5 minutes	Welcome & Recap of the last session Objectives of today's session
30 minutes	Presentation: • Integration of technology • Videos • Using the developed rubric to self-evaluate your FA practice
45 minutes	Demo class
15 minutes	Break
20 minutes	Feedback & Group Discussion
10 minutes	Closing Remarks Q& A

120 minutes