TITLE

# A framework for evaluating the user experience of digital moderation systems in the South African secondary school environment

by

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# Declaration Statement

I declare that “A framework for evaluating the user experience of digital moderation systems in the South African secondary school environment” is my own work and that all the sources that I have used or quoted have been indicated and acknowledged by means of complete references.

I further declare that I submitted the thesis to originality checking software. The result summary is attached.

I further declare that I have not previously submitted this work, or part of it, for examination at Unisa for another qualification or at any other higher education institution.

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Abstract

The continued emphasis on education quality amidst the accelerating pace of technological developments, which create new opportunities, expectations, and challenges in the teaching and learning environment, requires evidence-based, robust, regulatory frameworks for monitoring standards. Innovative and dynamic approaches are required to quality assure assessment processes (moderation). The reviewed literature provided scant evidence of theorization on the concept of digital moderation (eModeration) and little empirical evidence on systems used in secondary schools. This deficiency in the literature in terms of digital moderation is problematic since it leaves educators, managers, and researchers without evidence-based guidance on how eModeration systems should be designed or evaluated. This deficit provides the rationale for an investigation into the components of a framework to evaluate the user experience of an eModeration system. This study draws on the extant eModeration literature and theories of technology acceptance, Information Systems success (IS) models, and constructs from the field of Human-Computer Interaction (HCI) to create a theoretical framework that integrates constructs identified from the different literature streams to evaluate an eModeration system's user experience. A Design Science Research (DSR) approach guided the design, development, and evaluation of an eModeration evaluation framework. A Participatory Action Design Research (PADRE) approach was used to position the user within the iterative DSR cycles as a means of knowledge acquisition. Participatory Design (PD) was positioned as a data collection strategy during requirements gathering and the generation of design ideas for an eModeration prototype system. Qualitative and quantitative data collection was used to record perceptions of individuals interacting with the prototype. The theoretical contribution is the literature-based framework underpinning this study. This theoretical framework was used as input in determining the components of an eModeration evaluation framework, which is the main contribution of this study. This research has practical value in guiding the design of evaluation criteria for the user experience of an eModeration system for implementation in secondary schools.

**Keywords** (in alphabetical order): Design Science Research; eAssessment; eModeration; e-submission; Human-Computer Interaction; moderation; Participatory Action Design Research; Participatory Design; usability; user experience.

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# List of publications related to this study

1. Rajamany, Vanitha, Van Biljon, J., & Van Staden, C. (2020). eModeration adoption requirements for secondary school education: a critical literature review. *2020 Conference on Information Communications Technology and Society (ICTAS)*, *10*(1109), 1–6. https://doi.org/10.1109/ICTAS47918.2020.233979

2. Rajamany, Vanitha, Van Staden, C., & Van Biljon, J. (2020). Requirements for an eModeration System in Private Schools in South Africa. In M. Hattingh, M. Matthee, H. Smuts, I. Pappas, Y. K. Dwivedi, & M. Mäntymäki (Eds.), I3E2020 (Issue 1, pp. 557–568). Springer International Publishing. https://doi.org/10.1007/978-3-030-44999-5

3. Rajamany, Vanitha. (2020). *eModeration Requirements: A Case Study in Private Secondary Schools in South Africa*. Masters Dissertation, School of Computing, University of South Africa.

4. Rajamany, V, Van Biljon, J., & Van Staden, C. (2021). Research trends in the implementation of eModeration Systems : A Systematic Literature Review. In X.-S Yang et al. (Ed.), *Proceedings of Sixth International Congress on Information and Communication Technology* (pp. 139–146).

5. Rajamany, Vanitha, Van Biljon, J. A., & Van Staden, C. (2022). User Experience Requirements of Digital Moderation Systems in South Africa: Using Participatory Design Within Design Science Research. In A. Dreschler, A. Gerber, & A. Hevner (Eds.), The Transdisciplinary Reach of Design Science Research (pp. 470–482).

6. Rajamany, V, van Biljon, J. A., & van Staden, C. J. (2023). A User Experience evaluation framework for an electronic moderation system: a participatory design study involving South African secondary school teachers. In Education International (pp. 1–30) (Under review).

## List of Figures

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List of acronyms

| | |
|---|---|
| ACJS | Adaptive Comparative Judgement System |
| ADR | Action Design research |
| AR | Action Research |
| CA | Cronbach alpha |
| CSUQ | Computer system Usability Questionnaire |
| DR | Design Research |
| DSR | Design Science Research |
| DSRP | Design Science Research Process |
| DSRPM | Design Science Research Process Model |
| FAQ | Frequently Asked Questions |
| HCI | Human-Computer Interaction |
| HEI | Higher Education Institution |
| HOT-Fit | Human-Organization-Technology Fit |
| ICT | Information and Communications Technologies |
| IEB | Independent Examinations Board |
| IS | Information Systems |
| IT | Information Technology |
| LMS | Learning Management System |
| MOOC | Massive Open Online Course |
| NCS | National Curriculum Statement |
| NQF | National Qualifications Framework |
| PADRE | Participatory Action Design Research |
| PD | Participatory Design |
| POPIA | Protection of Personal Information Act |
| RM | Regional Moderator |
| SA | South Africa |
| SAQA | South African Qualifications Authority |
| SBA | School Based Assessment |
| SETA | Sector Education and Training Authority |
| SLR | Systematic literature review |
| SPARK | Self and Peer Assessment Resource Kit |
| SUS | System Usability Scale |
| TA | Thematic Analysis |
| TAM | Technology Acceptance Model |
| TOE | Technology-Organizational-Environmental framework |
| TTF | Task-Technology Fit |
| UEQ | User Experience Questionnaire |
| UNISA | University of South Africa |
| USE | Usefulness, Satisfaction and Ease of Use |
| UTAUT | Unified Theory of Acceptance and Usage of Technology |
| UX | User Experience |

# Chapter 1: Introduction

## 1.1. Background to the study

The increasing emphasis on the strategic importance of quality education in a knowledge-based society with dynamic technological environments requires innovative changes in quality assurance processes (moderation) (Volante, 2020). The global COVID-19 pandemic has refocussed attention on eLearning, which has necessitated a radical change in assessment processes to ensure that the validity, robustness, and integrity of assessments remain key when responding to increasing calls for accountability in education (Farhan et al., 2019; Burgess & Sievertsen, 2020; Motala & Menon, 2020).

The educational landscape is constantly impacted by the advent of new technologies. The introduction of technology in assessment practices presents an added dimension to the already complex tasks of planning lessons, teaching, and creating and administering assessments (Johnson et al., 2016; Frezzo, 2017; Shute & Rahimi, 2017; Scherer et al., 2019). Ensuring effective technology use is difficult and requires a contextualized understanding of the technology and the users, where chosen technologies may be modified to suit the pedagogical and assessment-related needs of different educational settings (Moyle, 2010; Koehler et al., 2013; Johnson et al., 2016). Considering the User Experience (UX) aspect of such systems could contribute to the acceptance and eventual impact of technology (Petrie & Bevan, 2009; Lew et al., 2010; Lehong, 2020).

Human-Computer Interaction (HCI) is the study of how the interaction between humans and computing technologies affects the activities and productivity of humans. A fundamental objective of HCI research is to make systems more usable and useful, while also providing users with a satisfactory experience in meeting their task objectives (Fischer, 2001). HCI theory focuses on two core concepts: usability and user experience (Hornbæk, 2006).

Essentially, usability indicates the degree to which users can utilize information systems (IS) to achieve specific goals (Desmet & Hekkert, 2007; Hassan & Galal-Edeen, 2017) and focuses on a user-centred design process to develop computer systems that are easy to learn and use (Grinberga, 2016; Adhiambo et al., 2017).

User experience (UX), which will be discussed in greater detail in **Section 2.5.3.4**, is a complex, multi-faceted term that includes aspects of a user's practical and emotional interaction with a system (Tan et al., 2013; Hassan & Galal-Edeen, 2017; Hussain et al., 2018). UX is subjective and largely dependent on the user, the context of use, and the potential benefit obtained from the system (Hassan & Galal-Edeen, 2017). UX is typically measured using constructs related to the usability of a system (Hussain et al., 2018). There are different streams of thought about the relationship between UX and usability, which are discussed in more detail in **Section 2.5.3.6**. This study considers UX as an umbrella term incorporating user perceptions, emotional reactions, and usability.

This chapter is structured as follows. **Section 1.2** presents the rationale for this study on eModeration. In **Section 1.3**, the research problem is articulated. **Section 1.4** presents the research questions. **Section 1.5** presents the theoretical grounding underpinning the study. **Section 1.6** presents the research design employed. **Section 1.7** presents the theoretical and practical contributions. **Section 1.8** illustrates the research planning. **Section 1.9** depicts the layout of the thesis. **Section 1.10** concludes this chapter.

## 1.2. Rationale

This section presents the challenges of quality assurance in the educational setting as rationale for an investigation into the evaluation of the user experience of an eModeration system. The challenges of quality assurance can be categorised according to changing educational practices, issues of reliability in assessment, and a need to optimize the moderation processes that are explained in the following discussion.

Considering the changes in educational practices, Häkkinen and Hämäläinen (2012), Shute and Rahimi (2017), and Hussin (2018) maintain that developments in mobile communication and social networking broaden learning contexts beyond traditional educational settings, thus changing and challenging the academic practices of an information society. Despite the digitalization of assessments, improvements in educational practices specifically regarding digital moderation are still not seen (Chia, 2016; Vergés Bausili, 2018; Gourdin et al., 2019; Van Staden et al., 2019).

A wide body of research provides empirical evidence of the increased delivery of online programs such as Massive Open Online Courses (MOOCs) in higher education, which makes quality assurance difficult (Booth & Rennie, 2015; Shute & Rahimi, 2017; Farhan et al., 2019). The need to support teacher assessment practices is especially important given the increasing focus of governments on the need for a resilient standardizing framework for monitoring quality standards in assessments (Booth & Rennie, 2015; Beutel et al., 2017; DeLuca & Johnson, 2017).

Traditionally, assessment has been a process of evaluating written submissions (Durcheva et al., 2019). Students are now increasingly producing digital evidence of learning (New-Zealand-Qualifications-Authority, 2016a). Developments in access to, and advances in, ICT services have facilitated the evolving field of eAssessment, which can be explained as the use of technology to support and manage the assessment process life cycle (Moccozet et al., 2018). The increased adoption of ICTs for the electronic submission (e-submission) and electronic marking (e-marking) of student submissions represent the most evident indication of a change in educational practices and digital assessment across HEIs (Redecker & Johannessen, 2013; Vergés Bausili, 2018).

eAssessment or eEvaluation is an essential component of successful online learning and teaching (Durcheva et al., 2019). Confidence in the validity and reliability of student results is an important issue associated with the eEvaluation process (Durcheva et al., 2019). Considering the reliability concerns of assessments, Redecker and Johannessen (2013) maintain that the adoption of ICTs in pedagogical processes requires careful consideration of the reliability of the assessment process. Guaranteeing the quality of eAssessment and demonstrating compliance with standards in an eLearning environment are essential for the efficacy of the educational process (Booth et al., 2016; Hidalgo et al., 2018). Ding (2017) maintains that electronic submissions and on-screen marking may compromise the reliability of the assigned marks and the quality assurance thereof.

Similarly, Durcheva et al. (2019) maintain that the necessity for fast, accurate assessment methods, which guarantee confidence in the reliability of the process, provide the biggest challenge for the broader implementation of eAssessments. Although digital technologies have undoubtedly enhanced most areas of study, it is questionable whether such technologies assure the academic veracity of assessments (Ding, 2017). Prior studies by Johnson and Greatorex (2008) indicate that viewing student submissions on screen as opposed to on paper may affect assessment judgments.

Increasing questions about the performance of eLearning systems have driven HEIs to test other resources and approaches in addressing the quality problems posed by the use of eLearning networks (Farhan et al., 2019). The increasing use of technology in all spheres of the educational arena, and the resultant changes in assessment practices, suggest the need fo a technology driven moderation process.

Online course implementation and delivery over multiple sites, combined with a focus on quality assurance, pose challenges for academics (Centre-for-Learning-and-Development, 2012). For many instructors the proliferation of dispersed university sites is a new environment progressively driven by calls for accountability (Grainger et al., 2019).

The increased use of ICTs in course delivery and for assessment purposes, reliability issues arising from the changing nature of assessments, and the need to optimise moderation processes necessitate rigorous and effective technology driven moderation processes to maintain the integrity of assessments.

However, unlike online assessment and electronic grading, which have been extensively researched and successfully implemented in HEIs, the digital moderation of assessed scripts is a comparatively new phenomenon (Van Staden et al., 2019). Despite debates around the benefits of digital moderation, Newhouse and Tarricone (2016) maintain that online moderation systems have not been fully implemented by educational systems. For instance, while Vergés Bausili (2018) describes the application of e-submission and e-marking technologies in an HEI, and provides a review of an organized approach to e-marking, no mention is made of the related process of quality assurance of these assessments or how the moderation process will differ, given the nature of assessment submissions and the related assessment methods. This lack of empirical evidence of dedicated eModeration systems and the corresponding eModeration processes provides a rationale for an investigation into the user experience of eModeration systems in secondary school environments. Moreover, a lack of theorization, specifically with regards to the user experience of an eModeration system, indicates a gap in the prevailing body of academic knowledge on eModeration systems.

The following section explains the purpose of the study and articulates the problem statement.

## 1.3. Research Problem

The lack of empirical research on eModeration processes is significant at a time when assessments in a post Covid-19 educational system will need to be adaptive to a situation that is still evolving.[1] The professional judgement of educators (developed and assured through moderation) will be pivotal in raising standards and expectations (Adams & Anderson, 2019).

The long-established paper-based method of moderation is time-consuming and costly (Van Staden, 2017). Changing ICT-mediated educational practices, the related reliability issues, and the need to optimise moderation processes demonstrate the impact of not having a streamlined digital moderation practice. Consequently, eAssessment needs innovative solutions for the quality assurance of assessments.

While acknowledging that various electronic assessment tools exist in HEIs, Van Staden et al. (2019) maintain that not much effort has been made to implement the available technologies in supporting moderation within the South African context. Most HEIs are still using conventional modes of assessment and moderation, which include manual hard-copy moderation. The necessity to improve student learning and the pressure on HEIs to reduce the turnaround time of marking places the moderation process under time pressure (Vergés Bausili, 2018), and is instrumental in accelerating a move from paper-based to digital methods of moderation (Van Staden et al., 2019).

Unlike face-to-face moderation, digital moderation offers unique possibilities to demonstrate specific qualities in student assessments via digital representations, whilst simultaneously involving educators from different areas in communication and evaluation activities. A thorough understanding of existing methods of assessment and the advancement of new or

[1] Available from: https://theconversation.com/what-will-happen-to-school-grades-during-the-coronavirus-pandemic-135632 [Accessed: 27/04/2020].

modified pedagogical processes are necessary for the effective adoption of these technologies (Vergés Bausili, 2018). The advantages of using digital systems include efficiency, cost-effectiveness, improved turnaround time, convenience, flexibility, and a reduction of consumables (ABC-Awards, 2014; Booth & Rennie, 2015). Specifically, within the South African context, the advantages of eModeration relate to overcoming the difficulties characteristic of a developing nation, such as unreliable and slow postal services, costly courier services, and the need to involve global professionals (Van Staden et al., 2019).

Notwithstanding the increasing significance of digitalization in most aspects of education and the importance of eModeration, the latter has not received notable consideration in research or practice, especially in South African secondary schools. As indicated in **Table 1-1**, there is no empirical evidence of UX metrics being considered in the implementation or evaluation of the eModeration systems discussed. Additionally, other than the eModerate system, none of the existing systems provide the basic functionality of allowing assessors to upload assessed evidence, using the system to conduct moderation processes, and allowing the assessor to download the moderated assessment. Furthermore, a lack of theorization on the components of a usable eModeration system in the secondary school environment is evident (see **Table 1-1**). The lack of research in this field strengthens the argument for research into eModeration in secondary schools. This argument is based on an overview provided by Rajamany et al. (2021), which revealed only five studies addressing quality assurance in HEIs and secondary schools. These studies are depicted in **Table 1-1**, with only two of the studies reporting on implemented systems.

Booth and Rennie (2015) reported on the initial two phases of a seven-phase project; therefore, the study does not offer any empirical verification of the application of a dedicated eModeration system. Similarly, although the New Zealand Qualifications' Authority embarked on a Digital Moderation Project for the online completion of external moderation ((New-Zealand-Qualifications-Authority, 2016a, 2016b), there is no indication of the successful implementation of the system in the New Zealand education system. In South Africa (SA), Van Staden et al. (2017) implemented an eModerate system at an HEI (see **Table 1-1**). The focus of their study was on the user experience of an eModeration system in the context of HEIs rather than the secondary school environment.

**Table 1-1: Summary of existing ICT moderation systems**

| System | Domain | Primary focus | Contribution | Features of system | Research design | Evaluation of system | Usability metrics used? | Evidence of implementation |
|---|---|---|---|---|---|---|---|---|
| Proof of concept trial using an online Self and Peer Assessment Resource Kit (SPARK) (Booth & Rennie, 2015). | HEI: Australia. | To provide a sustainable, cost-effective technological solution addressing quality assurance in HEIs. | The online tool should be context-sensitive; streamlined, efficient, cost-effective, sustainable, and fit for purpose. | N/A | N/A | No implemented system. | no | no |
| Adaptive Comparative Judgement System (ACJS) (Newhouse & Tarricone, 2016). | Secondary schools: Western Australia. | Use of an ICT system to support social online moderation using comparative judgements and online scoring of digital portfolios in Visual Arts. | The use of pairwise comparative judgements can help to increase the reliability of teacher judgements. | Pairs of digital portfolios are dynamically generated for each assessor; an area is provided for assessors to record individual notes about portfolios. | Action Research. | Easy to use and navigate. Time-consuming. | no | no |
| Digital Moderation Project (New-Zealand-Qualifications-Authority, 2016a, 2016b) | Secondary schools: New Zealand. | To determine teacher requirements for the submission of assessments via an online digital platform. | Inconclusive, no existing eModeration system could be found. | N/A | N/A | No implemented system. | no | no |
| eModerate system (Van Staden, 2017). | Private HEIs: South Africa. | The user experience of an eModeration system. | A user experience evaluation framework for an eModeration system. | Upload and download marked scripts; security; tracking of moderation; notification when moderation is complete. | Design Science Research. | Focus on user experience. | no | yes |

| System | Domain | Primary focus | Contribution | Features of system | Research design | Evaluation of system | Usability metrics used? | Evidence of implementation |
|---|---|---|---|---|---|---|---|---|
| Computer assisted evaluation system (Dessai & Kamat, 2018) | Public examination system: India. | Classification of evaluation anomalies using machine learning techniques. | Machine learning can accurately predict the scores of a second evaluator based on scores allocated by the first evaluator. | Marks assigned by different examiners are normalized to one common scale to control variations in evaluation. | Quantitative analysis using verification metrics. | No implemented system. | no | no |

Considering the studies discussed in **Table 1-1**, and despite the acknowledged benefits of improving moderation practices, it follows that the practical implementation of eModeration systems, specifically in secondary schools, is limited. Moderation is still largely paper-based at academic organizations in SA (Rajamany, 2020). The dynamic growth of online assessments compels the need for a usable, credible eModeration system.

These arguments point to a gap in the current body of knowledge and support the need for investigating a user experience framework to evaluate eModeration systems in secondary schools.

The problem statement can thus be articulated as: *There is currently no evidence-based framework that can be used to evaluate the user experience of an eModeration system in secondary schools.* The purpose of this study is therefore to develop a validated UX evaluation framework for digital moderation systems to be used in secondary schools.

## 1.4. Research questions

The current research is guided by the following main research question:

What are the components of a user experience evaluation framework for digital moderation systems for secondary schools?

The following sub-questions were articulated to assist in answering the main research question:

- **RQ1**: What are the components of an eModeration system?
- **RQ2**: What are the criteria that can be used to evaluate the user experience of an eModeration system?
- **RQ3**: How can independent secondary school teachers contribute to the design and validation of a user experience evaluation framework for an eModeration system?

## 1.5. Theoretical Grounding of the Research

This section presents an outline of the approach taken in the literature review, the philosophical paradigm underpinning the study, and the theoretical lens within which the different phases of the study were conducted.

### 1.5.1. Literature review approach

A literature review is an essential part of the research process that identifies what is currently known about a topic and is useful in determining gaps in existing knowledge. The literature review gathers information from many sources to provide the theoretical foundations and context of the research question (Cronin et al., 2008), thus enabling the researcher to understand the existing body of knowledge (Paré et al., 2015). Literature reviews provide an impartial, thorough overview, synthesis, and analytic assessment of previous research (Boell & Cecez-Kecmanovic, 2015; Cronin et al., 2008), and as such makes a vital contribution to the rigour and relevance of the research (Brocke et al., 2009).

Rigour is derived from the effective use of existing theoretical foundations and research methodologies, while relevance is improved by not reinvestigating that which is already known about a topic (Brocke et al., 2009). Brocke et al. (2009); Oates et al. (2012), and Wainwright et al. (2018) are among many researchers who have lent their voice to calls for more rigour in Information Systems (IS) research, arguing that it is essential for IS research to be relevant as well as rigorous. Despite these calls for relevance and rigour, Grover and Lyytinen (2015, p. 272) argue that IS knowledge is typically dictated by "epistemic scripts" that researchers use to "borrow" social theories arising from other disciplines. These theoretical constructs are generally applied in the IS context without any significant adaptation, thus reducing innovation in the production of knowledge (Grover & Lyytinen, 2015; Wainwright et al., 2018). These claims strengthen the argument for providing a rigorous literature review of current empirical evidence in the IS field.

According to Grant and Booth (2009) a systematized review is typically conducted by a postgraduate student. However, the term systematic literature review is generally accepted in the literature to refer to the process of adhering to specified guidelines when searching for, appraising and synthesizing evidence (Ellis & Levy, 2006; Pretto & Curró, 2017). Accordingly, a systematic literature review (see **Section 2.3**) was selected to analyze and synthesize existing empirical evidence of eModeration systems.

In contrast to a traditional literature review process, a systematic literature review (SLR) is a transparent, fully documented, and methodologically rigorous process that is traceable and repeatable (Barn et al., 2017; Kitchenham et al., 2009; Oates et al., 2012; Pickering & Byrne, 2014; Wainwright et al., 2018). SLRs provide new perspectives to the topic being reviewed, thus generating new knowledge (Pérez-Sanagustín et al., 2017). The benefits of SLRs, as identified by Barn et al. (2017), include improved precision, fairness, trustworthiness, and auditability.

Several studies provide guidelines around the activities to carry out in conducting an SLR, including the following outlined by Kitchenham (2004) and Oates et al. (2012):

- Identify the research question;
- Develop a strategy for searching existing literature;
- Search for individual studies (primary studies) contributing to the topic;
- Use explicit inclusion and exclusion criteria to include or exclude articles;
- Assess the validity of the findings from the primary studies;
- Extract and process the data from each primary study;
- Use analytical methods to synthesize the data; and
- Write and disseminate the report.

Based on the guidelines provided, and drawing largely on the works of Ellis and Levy (2006) and Pretto and Curró (2017), a detailed five-stage process of conducting an SLR is described and implemented in Chapter Two (see **Section 2.4**). The following section outlines the philosophical paradigms underpinning this thesis.

### 1.5.2. Philosophical paradigms

A research paradigm refers to "a system of beliefs and assumptions about the development of knowledge" (Saunders et al., 2016, p. 124). Saunders et al. (2019, p. 130) and Guba and Lincoln (1994, p. 107) define paradigms as a "set of basic beliefs" that represent an individual's worldview. Typically, a paradigm consists of "assumptions about knowledge and how to acquire it" (Hirschheim & Klein, 1989, p. 1201). Guba and Lincoln (1994, p. 108) maintain that a researcher's basic beliefs can be summarized by their responses to three fundamental but interconnected questions, namely, (1) what is the nature of reality?; (2) what is the nature of the relationship between that which is known and the knower?; and (3) how can the researcher find out what is to be known?

Irrespective of the order in which these questions are answered, the response to any one of them restricts how each of the other questions is answered and informs the course of the research (Guba & Lincoln, 1994). In addition to these questions, axiology is concerned with the "nature of ethics" and what researchers value in their research efforts (Biddle & Schafft, 2015, p. 321).

Philosophical paradigms influence the practice of research and inform the choice of research methods (Feilzer, 2010; Kivunja & Kuyini, 2017). During every stage of the research process, all researchers make assumptions (Saunders et al., 2019), typically involving the realities encountered (ontology), assumptions about human knowledge (epistemology), and assumptions about the degree to which the researcher's values influence the research process (axiology). The researcher's assumptions shape how the research questions are understood, the data collection methods used, and how the findings of the study are interpreted (Saunders et al., 2019).

Kivunja and Kuyini (2017) stress the importance of researchers locating their research within a particular research paradigm. In line with this view, Guba and Lincoln (1994), Curtin (2012), Morgan (2014), Biddle and Schafft (2015), and Saunders et al. (2019) outline the essential elements of any paradigm and highlight the importance of researchers understanding these elements so that the research is sustained and guided by the theories of the chosen paradigm.

Curtin (2012, p. 32) succinctly summarizes these elements and their place within research as "What we believe to be the object of study (ontology) guides how we know it (epistemology), study it (methodology), and ultimately what we value about it (axiology)". The interpretivist and pragmatist paradigms framed the data collection and analysis in this study (see **Section 4.2.3**). The ontology, epistemology, axiology, and methodology as applicable to this thesis and paradigmatic approaches are compared and discussed in greater detail in **Section 4.2**.

The following section describes the theoretical framework that underpins this thesis.

### 1.5.3. Theoretical framework

The foremost function of theory is to provide a framework for making sense of the researcher's observations as to why the world is the way it is (Maxwell, 2013). The eModeration focus of this thesis lies at the intersection of HCI and IS. Technology Acceptance Models are fundamental in predicting users' acceptance of technology based on the technology's function, its ease of use and the benefits that arise out of its use (Tarhini et al., 2015). HCI on the other hand, includes subjective attributes into the design space which has traditionally been concerned with ease of use (Ardito et al., 2007). It was therefore necessary to interrogate current research in the fields of technology acceptance, IS and HCI, so as to position this research. The steps taken in guiding the development of a theoretical framework to support this thesis were to first outline the Technology Acceptance Models of interest and their general implementation of use. Secondly, two IS success models, namely, the original D&M Success Model and the updated D&M Success Model, were discussed. Thirdly, constructs from the field of Human-Computer Interaction (HCI) were presented. Lastly, the constructs applicable to the eModeration context from each of Technology Acceptance Models, IS Success Models, and HCI were included in the theoretical framework underpinning this study.

#### 1.5.3.1. Technology Acceptance Models

Technology acceptance models predict adoption decisions of information technologies in the workplace (Singh & Mansotra, 2019). In line with Blythe et al's. (2007, p. 4) view that UX is "complementary to technology acceptance models", the TAM, UTAUT, TOE, TTF, and HOT-Fit models were considered for applicability to the eModeration context (see **Section 3.4**). These models are briefly outlined in **Table 1-2** in terms of their usage context, basic premise behind each model, the limitations (if any), and the constructs applicable to the eModeration context. A more detailed discussion of these models is presented in Chapter Three (see **Section 3.4**).

### Table 1-2: Technology acceptance models

| Model | Usage contexts | Basic premise | Limitations | Constructs applicable to eModeration |
|---|---|---|---|---|
| Technology Acceptance Model (TAM) | Business environments<br>Education. | An individual's intention to use a system is predicated by the belief that using the system will:<br>➢ enhance their job performance (perceived usefulness); and<br>➢ be effortless (perceived ease of use) (Venkatesh & Bala, 2008). | Excludes social, psychological, and organizational factors (Awa et al., 2016). | ➢ Ease of use<br>➢ Usefulness. |
| Unified Theory of Acceptance and Usage of Technology (UTAUT) Model | Business environments<br>Mobile commerce<br>Education. | User adoption and usage is influenced by performance expectancy, effort expectancy, social influence, and facilitating conditions (Venkatesh et al., 2003). | Only examines the effects of the constructs on behavioural intentions (Hariyanti et al., 2018; Lai, 2017). | ➢ Effort expectancy (learnability)<br>➢ Performance expectancy (usefulness)<br>➢ Facilitating conditions (user knowledge and support)<br>(Ain et al., 2015; Lai, 2017). |
| Technology-Organizational-Environmental (TOE) framework | Interorganizational systems<br>E-business<br>Digital data interchange<br>Cloud computing<br>General applications<br>(Korpelainen, 2011; Borgman et al., 2013; Awa et al., 2016). | Provides a theoretical framework for IT adoption. Distinguishes between three contexts determining the adoption and implementation of technology, i.e.:<br>➢ technology context,<br>➢ organizational context,<br>➢ environmental context (Borgman et al., 2013). | Focuses only on the fit between user and task. Ignores context (Mohamadali & Garibaldi, 2012). | ➢ Technology characteristics<br>➢ Task characteristics. |
| Task-Technology Fit (TTF) | Cloud computing<br>Mobile banking<br>Wireless technology<br>(Tripathi & Jigeesh, 2015; Yen et al., 2010; Zhou et al., 2010). | New technology will only be utilized if the functionality 'fits' the activity of the user (Röcker, 2010). Users will choose the technology that is most appropriate for the task that they wish to accomplish. | TTF does not include aspects to establish the effectiveness of a system nor does it include the social context (Rai & Selnes, 2019). | ➢ Task characteristics<br>➢ System functionality (Röcker, 2010). |
| HOT-Fit framework | Health IS<br>eGovernment<br>eLearning. | A model for understanding the interrelated aspects of humans, organization, and technology (Erlirianto et al., 2015). | | ➢ Human<br>➢ Technology. |

The following section presents an overview of the IS success models.

#### 1.5.3.2. IS Success Models

Delone and McLean (1992) proposed a model for operationalizing IS success. The original D&M IS success model provides a thorough understanding of IS success by distinguishing six interdependent variables thereof (system quality, information quality, IS use, user satisfaction, individual impact, and organizational impact) and describing the relationships between these variables (Delone & McLean, 1992). Seddon and Kiew (1996) subsequently suggested a change in focus from use to usefulness, indicating that usefulness is a better measure of IS success than use when system use is mandatory. This view has parallels with proven constructs used in technology acceptance models, where the concept of usefulness is equivalent to the idea of perceived usefulness in TAM (Petter et al., 2008). The updated D&M model includes service quality as a construct and replaces individual impact and organizational impact with net benefits so that the model can be applied to the most relevant level of analysis (DeLone & McLean, 2003; Petter & McLean, 2009). IS Success Models are discussed further in **Section 3.5**.

#### 1.5.3.3. Human-Computer Interaction (HCI)

HCI is a field of research that studies the design and use of information and computing technologies (ICTs) (Kuutti, 1995). Usability and user experience (UX), which are core components of HCI, are discussed in the following sections.

##### 1.5.3.3.1. Usability

Usability refers to the quality of the user interface (Hariyanto et al., 2020). Amongst efforts to explain what the term means, usability has been described as the capability to be used by humans easily and effectively (Hornbæk, 2006); ‘‘quality in use’’ (Bevan, 2001, p. 541); and the ‘‘extent to which a system, product or service can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use’’ (ISO-IEC, 2018).

##### 1.5.3.3.2. User experience (UX)

The term user experience (UX) has arisen from the realization that, as IS becomes more ubiquitous, users require more than just systems that are easy to use (Petrie & Bevan, 2009; Lehong, 2020). People do not merely want to accomplish tasks, but also want to enjoy their interaction with an IT system. UX has thus emerged to encompass users' interactions with, and reactions to, IT systems that go beyond the effectiveness, efficiency, and satisfaction measures as outlined by the ISO (Petrie & Bevan, 2009).

The ISO defines user experience as a person's "perceptions and responses that result from the use and/or anticipated use of a system, product or service" (ISO-IEC, 2018). While usability focuses on user cognition and performance in human-technology interactions, UX highlights the non-utilitarian aspects of these interactions (Law et al., 2009). The user experience is therefore a holistic concept that includes all forms of emotional, cognitive, or physical reactions concerning the use of a system formed before, during, and after use (Hinderks et al., 2019).

### 1.5.4. Components included in the theoretical framework for this study

There is no stipulation of a specific system to be used in the moderation of assessments in the SA secondary school environment (see **Section 2.5.1.3.4**). The choice of system is up to specific schools and, at a more granular level, specific individuals. Based on a comparison of the Technology Acceptance Models' applicability to eModeration usability constructs, the constructs from the HOT-Fit framework were deemed to be the most pertinent for inclusion in this thesis (see **Table 3-1**). Since the HOT-Fit framework builds on previous IS success models (Erlirianto et al., 2015; Yusof et al., 2008), there are obvious parallels between the HOT-Fit framework (see **Figure 1-1)** and the components identified from the D&M Success model (see **Figure 1-2).** The components pertinent to this thesis are highlighted in **Figure 1-1** and **Figure 1-2.**

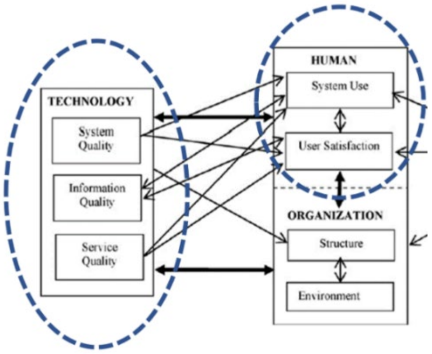



**Figure 1-1: Hot-Fit Framework**

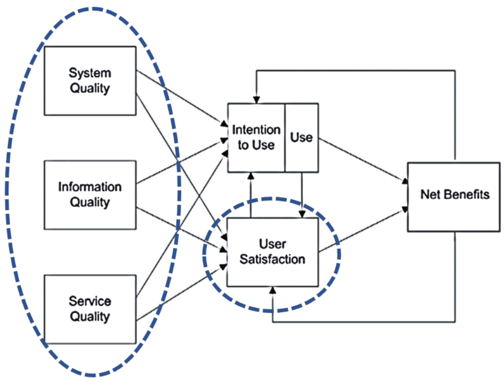



**Figure 1-2: Components of the D&M Success model**

Given that the organizational context determines the system capabilities and infrastructure provided, the organization component from the HOT-Fit framework was incorporated into the system component (see **Figure 3-14**).

Additionally, the components identified from the outline of Technology Acceptance Models (see **Table 1-2**) were categorized as relating to the user, the task, and the system. A high-level overview of the components included in the theoretical framework is indicated in **Figure 1-3**. A more granular representation is provided in Chapter Three (see **Figure 3-14**).

The identified constructs from Technology Acceptance Models are ease of use, effectiveness, efficiency, learnability, context of use and flexibility. The usability constructs are depicted as the measures of quality in use, namely, effectiveness, efficiency, satisfaction, learnability, and flexibility. Service quality, information quality, and system quality influence the value derived from using the system.

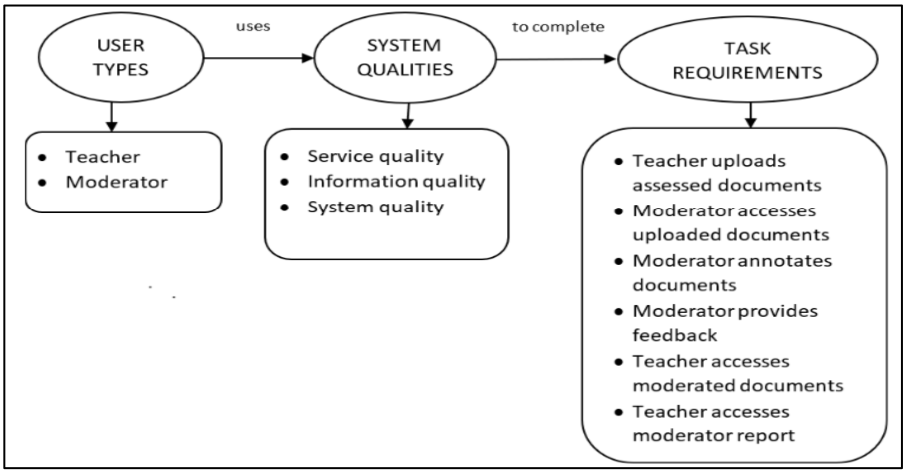



**Figure 1-3: High-level overview of components included in the theoretical framework**

## 1.6. Research design

The research design aligns with the pragmatic and interpretivist approaches (see **Section 1.5.2**) taken in this study. Design, in an organizational context, is an open-ended process with a focus on the analysis of needs together with the design of specific functionalities. Gregor et al. (2020, p. 1625) contend that the main form of theory in IS research should be theory for "design and action", with DSR as one way of responding to calls for academics to engage in work that has greater impact outside of academia.

Hevner and Chatterjee (2010, p. 13) argue for the value of Design Science Research (DSR) in "addressing the relevancy gap" in academia. Heeding this argument, Naidoo et al. (2012) assert that DSR's intent to create an artefact through a balanced process that combines the highest standards of rigour with a high level of relevance has the potential to reduce the relevance gap between computing research and practical problems, thus fostering stronger relationships between researchers and practitioners. The use of DSR in the development of the eModeration evaluation framework combines theory and practice, thus ensuring a high level of rigour in the development of artefacts serving a practical purpose (Hevner & Chatterjee, 2010).

The evaluation of an artefact motivated the use of DSR in this study. Empirical evidence indicates that the focus of DSR is on the artefact, with very little attention being paid to the role-players in the various stages of the DSR process (Gregor et al., 2020; Van der Merwe et al., 2020). While acknowledging that several studies include users in the DSR process, Haj-

Bolouri (2015, p.12) posits that the "techno-centric and problem-solving" focus of DSR precludes the user as a "central" component of DSR. Heeding Bodker and Pekkola's (2010) argument for user participation and the need for knowledge sharing in the design process, Participatory Design (PD), as a data capturing strategy (see **Section 4.2.2.2**) and a Participatory Action Design Research (PADRE) approach (see **Section 4.2.2.8**) are included to position the user and incorporate learning and reflection during each stage of the DSR process as advocated by Haj-Bolouri et al. (2016).

Van der Merwe et al. (2020) propose six guidelines for the development of a study using DSR. The proposed guidelines, together with the method used to implement them in this thesis, are illustrated in **Table 1-3**.

**Table 1-3: Guidelines for DSR Research**

| **Guidelines** | **Method** | **Practical implementation** |
|---|---|---|
| Contextualise DSR in the field of Information Systems and be able to distinguish between concepts such as design, Design Science, and DSR. | Literature Review on DSR. | Chapter Four: Discussion of what makes DSR relevant to IS research (**Section 4.2.2.1**). |
| Understand the philosophical underpinning of research and discourse on the nature of DSR. | Research Design: Literature Review on Philosophical Viewpoints. | Chapter Four: Discussion of ontological epistemological and axiomatic stance (**Section 4.2.1**). Discussion of methods employed for data collection (**Section 4.2.3.1**). |
| Obtain a historical perspective of DSR and consult the work of pioneers in the field. | Literature Review on DSR. | Chapter Four: Discussion of DSR contributions relevant to IS research (**Section 4.2.2.1.1**). |
| Consider the role of the artefact in DSR and the different views on design theory. | Artefacts:<br>➢ eModeration Prototype<br>➢ Evaluation framework. | Chapter Five: Discussion of prototype (**Section 5.3.4**).<br>Chapter Eight: Evaluation framework (**Section 8.7**). |
| Select an appropriate DSR method for the execution of the study. | Participatory Action design research (PADRE)<br>Participatory design for a collection of data within PADRE cycles of planning, implementing, evaluating, and reflecting, with learning occurring throughout all cycles of evaluating and reflecting on the knowledge. | Chapter Four: Data collection strategy using a PADRE approach (**Section 4.2.2.8**). |
| Strategize on how research in DSR should be communicated in a report. | Compilation of thesis. | All chapters: Completion of thesis. |

The DSR process followed in this study is described in detail in Chapter Four (see **Section 4.2.2.1**). The following section describes the qualitative and quantitative data collection and analysis methods employed in this study.

### 1.6.1. Data collection and data analysis methods

This study employed both qualitative and quantitative data collection methods. Qualitative methods, as recommended by Creswell (2014), are useful in exploring new topics not covered by existing theories, as such providing in-depth understanding of participants' views. This approach values documenting real experiences in context, by considering user perspectives (Patton, 2015). The researcher's experiences influence how this information is interpreted (Creswell, 2014; Patton, 2015).

Quantitative research is empirical and explains phenomena based on numerical data (Yilmaz, 2013). Quantitative data collection methods yield precise, numeric data. Statistical analysis of data by using software is more efficient than qualitative data analysis. Additionally, research results are researcher-independent, thus enhancing credibility (Johnson & Onwuegbuzie, 2004).

The choice between qualitative and quantitative research methods depends on the nature of the research problem (Creswell, 2014). If an intervention is required, a quantitative approach is appropriate, but if a concept requires exploration due to a lack of previous research, a qualitative approach is suitable. Qualitative data analysis seeks patterns and themes in the data without predetermined categories, leading to deeper, more detailed, and open analysis (Patton, 2015).

Quantitative data measures the prevalence of a phenomenon, while qualitative methods explain its meaning (Patton, 2015). A mixed methods design, combining both approaches, is useful when either method alone is insufficient to fully understand the research problem. This approach offers the greatest understanding (Creswell, 2014). Johnson and Onwuegbuzie (2004, p. 16) argue that research approaches "should be mixed in ways that offer the best opportunities for answering important research questions". This study employed an exploratory sequential approach combining qualitative and quantitative data (Cresswell, 2014) starting with a qualitative phase to examine participants' views (see **Section 4.2.2.2**). The analyzed data (see

**Section 5.3**) fed into the second, quantitative phase, using the qualitative phase to refine the prototype and determine appropriate instruments to use in the quantitative phase (Creswell, 2014). Braun and Clarke's (2006) thematic analysis was employed to analyze the qualitative data. These processes are explained further in Chapter Five.

### 1.6.2. Research flow process

The research was conducted in three phases (see **Figure 1-4**).

➢ Phase 1 (Change and Impact and Relevance Cycles of DSR): Literature review and data collection

- A literature review on eModeration, Technology Acceptance Models, HCI and IS Success Models informed the extrapolation of eModeration system requirements and components.
- A theoretical framework was abstracted from the literature review.
- The theoretical framework identified the UX constructs to be used as a basis for the development of the evaluation framework.
- The theoretical framework (informed by literature) and identified UX constructs provided a basis for the development of the first iteration of a prototype (see **Appendix A**).
- Prototype (Version 1) and literature findings guided the design of activities for PD workshops.
- Two PD workshops provided the opportunity for eliciting the requirements (see **Appendix B**) and design ideas for an eModeration system (Appendix C).
- An analysis of the data collected from the PD workshops informed the refinement of prototype (Version 1) to develop the second iteration of the prototype (see **Appendix D**).

- Prototype (Version 2) was deployed to members of one private school (School #1; N = 40).

- A questionnaire (see **Appendix E**) informed by the literature review and prototype (Version 2) was disseminated via Google forms to teachers and moderators (N = 40) who engaged with the prototype eModeration system (school #1).

- The data analysis of the quantitative and qualitative data from the online survey was used to extract initial UX criteria (Version 1) required to evaluate an eModeration system. Pre- and post-usage guidelines were developed to inform the focus group interviews.

➢ Phase 2 (Design Cycle of DSR): Prototype Evaluation

- Focus group interviews (see **Appendix F**) were conducted with members of each faculty (N = 32) in school #1.

- Data from the focus group interviews was used to extract domain-specific UX evaluation criteria (Version 2).

- An analysis of the UX evaluation criteria (Version 2) was used to extract domain-specific UX evaluation criteria which informed the development of an initial UX evaluation framework (Version 1) and amended pre- and post-usage guidelines (Version 2).

➢ Phase 3 (Rigor Cycle of DSR): Evaluate the framework

- Interviews (see **Appendix G**) were conducted with domain experts, that is, two national examiners (school#2), national moderators, cluster moderators, an ICT manager (school #2), and members of an assessment body (N = 8) to evaluate the initial UX evaluation framework (Version 1).

- The UX evaluation framework (Version 1) and pre- and post-usage guidelines were refined based on interviewee feedback.

- A validated eModeration UX evaluation framework (see **Table 8-5**) was developed to include pre-and post-usage criteria.

- Refined guidelines (see **Table 8-6**; **Table 8-7**; **Table 8-8**) were developed for stakeholders (teachers, moderators, ICT managers, organizations, and members of assessment bodies) to evaluate an eModeration system.

The complete research flow process is depicted in **Figure 1-4**. Phase one will be discussed in chapters two, three and four. Phase two will be discussed in chapters five, six, seven and eight. Phase three will be discussed in chapters eight and nine.

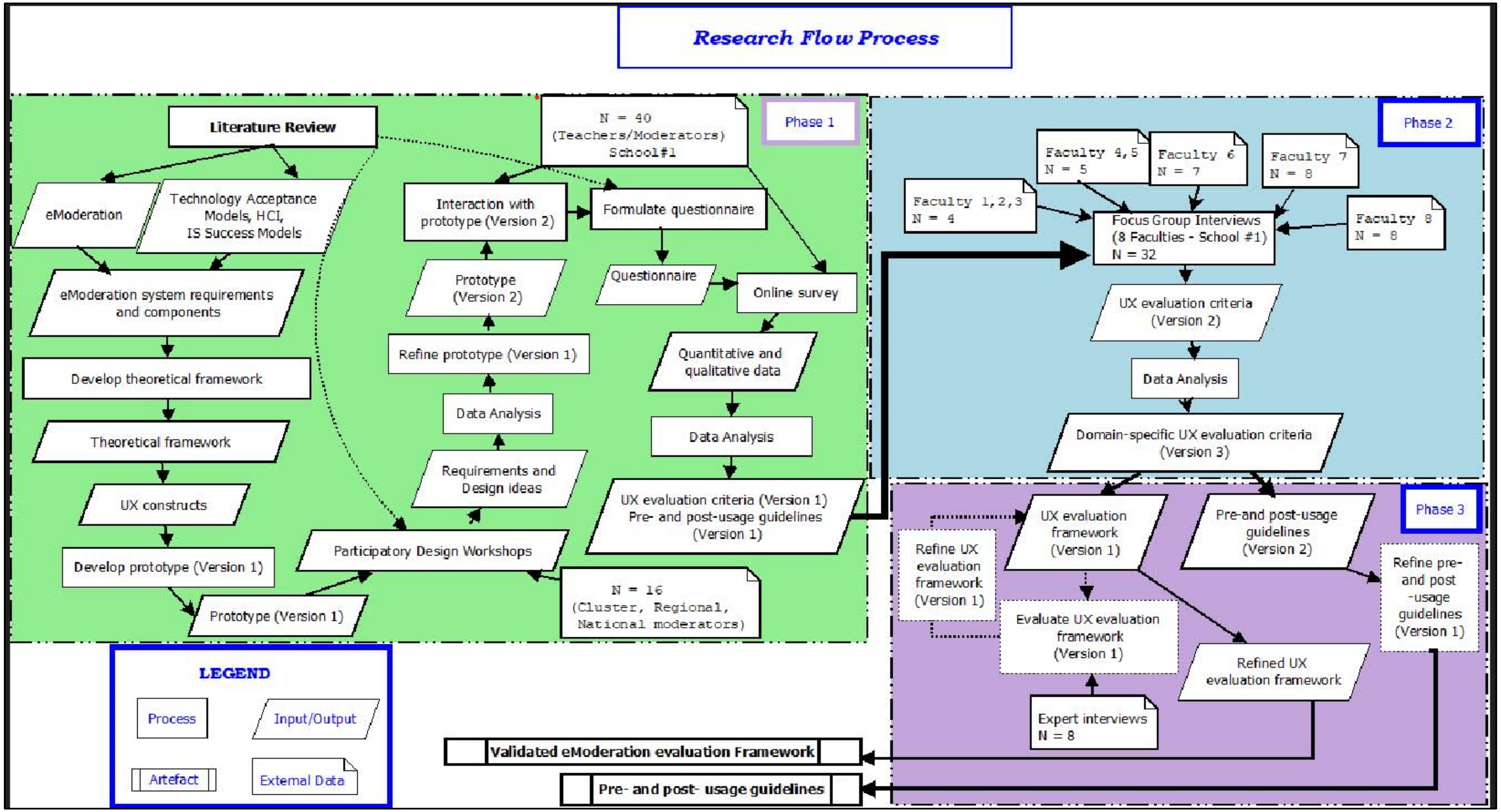



**Figure 1-4: Research Flow Process**

## 1.7. Contributions

The findings provide theoretical contributions to the body of knowledge regarding the UX of eModeration systems, as well as practical implications for eModeration service providers.

### 1.7.1. Theoretical Contributions

This study adds to the field of IS success by first creating a theoretical framework based on the fields of HCI, Technology Acceptance, and IS Success Models for the evaluation of an eModeration system. Secondly, a literature review together with teacher insights were used to contribute a refined list of requirements for an eModeration system. Lastly, pre- and post-usage criteria, extrapolated from an analysis of the findings, informed the development of guidelines for evaluating an eModeration system.

### 1.7.2. Practical Contribution

The development of a prototype (practical contribution) provided a basis for the development of a UX evaluation framework for the evaluation of an eModeration system in the secondary school environment. As a practical contribution, the eModeration evaluation framework can be utilized by software engineers in the development of eModeration systems. Pre-usage criteria inform the design of eModeration systems, while post-usage criteria inform the selection of an appropriate system based on the organizational context.

Previous studies lack a theoretical basis for evaluating the systems proposed. Additionally, there is no empirical evidence of usability metrics being considered in the implementation or evaluation of the systems discussed (see **Table 1-1**). This study adds to existing knowledge by presenting the practical implementation of a UX framework and empirical evidence from literature and teacher contributions to the theoretical and empirical deficiencies in the existing knowledge base.

## 1.8. Research planning

**Table 1-4: Research planning**

| Stage | Activities | Parties involved | Instrument applied | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 | Mar-22 | Apr-22 | May-22 | Jun-22 | Jul-22 | Aug-22 | Sep-22 | Oct-22 | Nov-22 | Dec-22 | Jan-23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage 1: Ethical clearance for the study. | Application for research ethical clearance (Chapter 1). (Ethical clearance was granted on 5 October 2021). | Supervisors, Researcher, UNISA. | Application forms. | | | | | | | | | | | | | | | | | | | | | | |
| Stage 2: Research methodology. | Drafting of the research design and methodology chapter. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 3: Literature Review. | Two-part systematic review of the literature. Part 1: The need for and requirements of an eModeration system and existing models. Part 2: Technology acceptance Models, IS, and HCI related to the requirements and design of the prototype. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 4: Development of prototype. | Use building blocks established through literature reviews to develop the prototype. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 5: Participatory Design Workshops. | Data collection phase - functional and user requirements collected (28th and 29th October 2021). | Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 6: Data analysis and refinement of the prototype. | Analyse and interpret the qualitative data to inform the refinement of the prototype. | | Qualitative data analysis methods. Qualitative software - Atlas.ti Version 9. MS Excel 2016. | | | | | | | | | | | | | | | | | | | | | | |

| Stage | Activities | Parties involved | Instrument applied | Apr-21 | May-21 | Jun-21 | Jul-21 | Aug-21 | Sep-21 | Oct-21 | Nov-21 | Dec-21 | Jan-22 | Feb-22 | Mar-22 | Apr-22 | May-22 | Jun-22 | Jul-22 | Aug-22 | Sep-22 | Oct-22 | Nov-22 | Dec-22 | Jan-23 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Stage 7: Evaluation of prototype. | Data collection phase - user experience constructs. | | Online survey.<br>Focus group interviews. | | | | | | | | | | | | | | | | | | | | | | |
| Stage 8: Data analysis.<br>Extraction of UX evaluation constructs.<br>Initial UX evaluation framework. | Develop initial UX evaluation framework. | | Qualitative and quantitative data analysis methods.<br>Qualitative software - Atlas.ti Version 9.<br>Quantitative software IBM SPSS Statistics 27.0. | | | | | | | | | | | | | | | | | | | | | | |
| Stage 9: Evaluation and refinement of UX framework. | Data collection and analysis to inform refinement of UX evaluation framework. | | Qualitative and quantitative data analysis methods.<br>Qualitative software - Atlas.ti Version 9.<br>Quantitative software IBM SPSS Statistics 27.0. | | | | | | | | | | | | | | | | | | | | | | |
| Stage 10: Final validated evaluation framework. | Suggestions for final validated evaluation framework. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 11: Conclusion, reflection and synthesis. | Completion of thesis. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 12: Language editing and formatting. | Editing and formatting of thesis. | Supervisors, Researcher, Language editor. | | | | | | | | | | | | | | | | | | | | | | | |
| Stage 13: Finalization and submission. | Finalization of thesis. | Supervisors, Researcher. | | | | | | | | | | | | | | | | | | | | | | | |

## 1.9. Thesis Layout

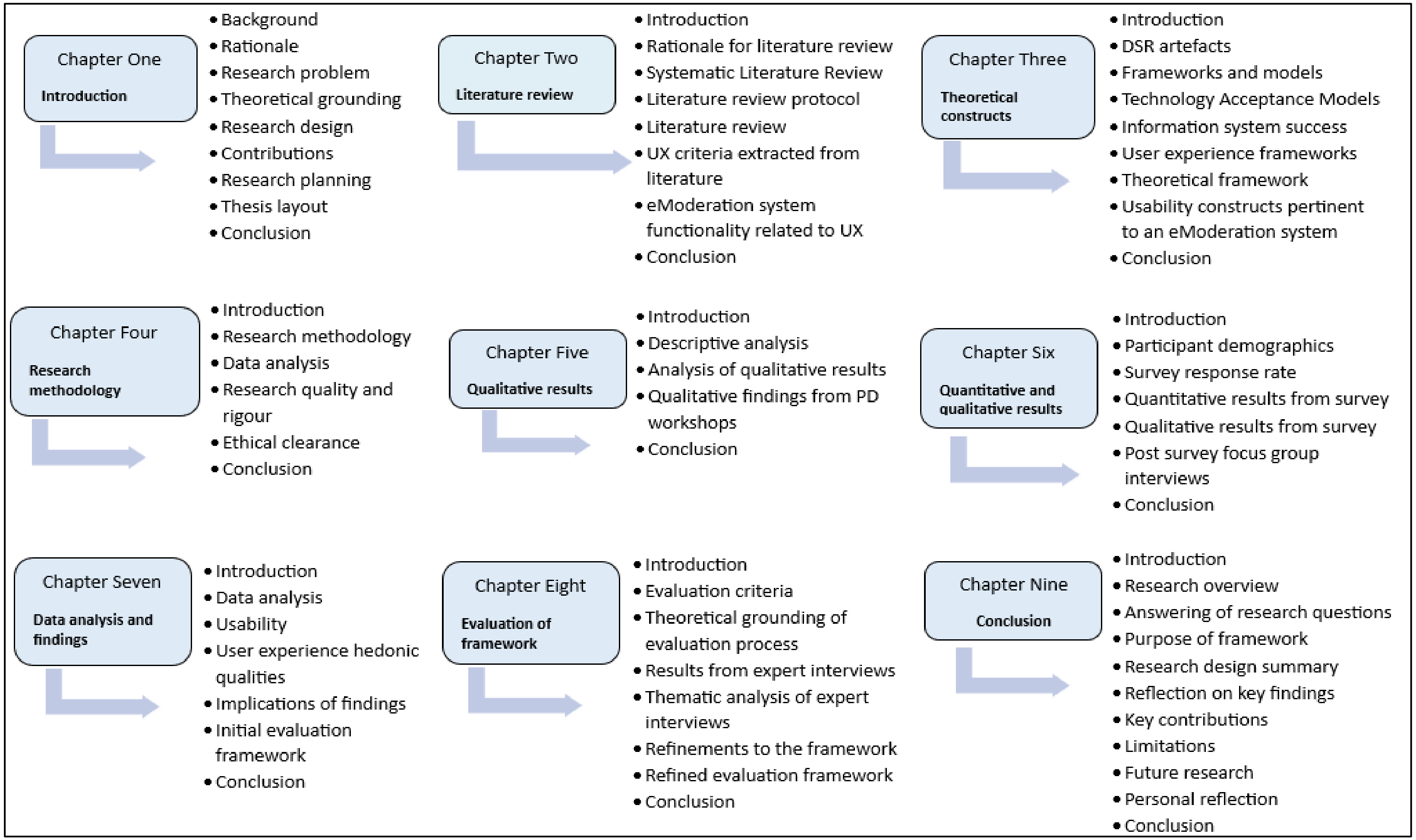



**Figure 1-5: Roadmap of thesis**

## 1.10. Conclusion

This chapter introduced the background and rationale for the present study in light of the growing trend of digitization in educational practices and the lack of empirical research on digital moderation systems. The research problems and research questions were articulated, and the theoretical foundations of the thesis were then established, including the research paradigms, relevant theoretical frameworks, research design and data collection and analysis strategies, as well as the delimitations, constraints, and assumptions. The significance and contributions of this study were also discussed. The chapter concluded with an overview of the organization and structure of the thesis. Chapter Two follows with a review of the literature on moderation and introduces the field of Human-Computer Interaction, along with the key constructs used for evaluating an eModeration system.

# Chapter 2: Literature Review

## 2.1. Introduction

Chapter One provided the rationale for this study, described the research problem, and articulated the research questions. The objective of this chapter is to provide answers to research questions one and two, namely:

- **RQ1:** What are the components of an eModeration system?
- **RQ2:** What are the criteria that can be used to evaluate the user experience of an eModeration system?

This chapter is positioned within the Relevance cycle of the Design Science Research process. **Section 2.2** presents an overview of the rationale for a literature review. **Section 2.3** provides a description of a systematic literature review. **Section 2.4** presents a description of the literature review protocol undertaken to answer research questions one and two posed in Chapter One. **Section 2.5** presents a literature review describing moderation, eModeration, and the moderation processes specifically within the secondary school environment in the South African (SA) context, followed by a literature review of the field of HCI to extract user experience constructs to be used for the evaluation of an eModeration system. **Section 2.6** presents UX criteria extracted from the extant literature for the evaluation of an eModeration system. **Section 2.7** presents the eModeration system functionality related to user experience. **Section 2.8** concludes Chapter Two.

## 2.2. Rationale for a Literature Review

A literature review was conducted to determine what models and technologies currently exist for digital moderation of assessments in the secondary school environment. A literature review is a central component of a thesis, providing the context as well as the structure for the development of the thesis (Paré et al., 2015). The literature review thus demarcates the scope of the research.

The importance of conducting a comprehensive literature review in research is widely recognized by scholars such as Pickering and Byrne (2014), Boell and Cecez-Kecmanovic (2015b), and Barn, Barat, and Clark (2017). Literature reviews serve as a foundation for advancing knowledge in a specific area and aid in identifying areas for further investigation. By synthesizing and critically evaluating previous research, literature reviews provide a comprehensive overview of existing theories and methodologies in the field of study (Pickering & Byrne, 2014; Barn et al., 2017). Through a thorough examination of the existing literature, researchers can identify gaps that can be addressed through their research (Pickering & Byrne, 2014; Boell & Cecez-Kecmanovic, 2015b).

A synthesis of the extant literature is essential to its effectiveness (Boell & Cecez-Kecmanovic, 2015a). This stage involves transitioning from an author-centric to a "concept-centric" focus, where the researcher analyzes how various topics are addressed across the body of literature, rather than simply summarizing findings (Okoli and Schabram, 2010, p. 31). The literature review thus explores the breadth and depth of relevant knowledge. Assessing the strengths and limitations of the existing literature is a critical aspect of a thorough literature review. In the field of IS, it is important for researchers to identify existing research on tools, technologies, theories, and procedures to make balanced, scientifically sound decisions (Barn et al., 2017).

Boell and Cecez-Kecmanovic (2015a) argue that literature reviews that are not thorough and impartial are of little scientific value. This argument provides a rationale for conducting a systematic literature review in this study. The following section describes what a Systematic Literature Review (SLR) is, and outlines the process followed in conducting a literature review on moderation.

## 2.3. Systematic Literature Review explained

A systematic literature review is a comprehensive and structured approach to evaluate existing research on a specific topic (Boell & Cecez-Kecmanovic, 2015a); it comprises a methodologically meticulous examination of results obtained from research (Kitchenham et al., 2009). It aims to provide a comprehensive and objective overview of the current state of knowledge in the field of study. To conduct a systematic literature review, a well-defined and structured methodology must be followed to ensure that all relevant literature is identified and included. The process of conducting a systematic literature review involves the formulation of research questions, identification and selection of relevant literature, data extraction and analysis, and synthesis of findings (Kitchenham et al., 2009).

An explicit and systematic methodology reduces the likelihood of bias and increases the validity of the SLR findings (Grant and Booth, 2009; Pickering and Byrne, 2014). The rigorous and systematic process of an SLR also provides a clear and comprehensive understanding of the current state of knowledge on a particular topic and helps to identify gaps in existing literature. The use of predefined and explicit methods in conducting an SLR helps to ensure the comprehensiveness, impartiality, and transparency of the literature review process, which facilitates the replication of the process (Barn et al., 2017; Boell & Cecez-Kecmanovic, 2015a, 2015b).

Grant and Booth (2009) identify the drawing together of all known knowledge on a topic area as a strength of an SLR. On the other hand, by limiting the studies included to a single study design, the SLR can be impeded in seeking answers to more complicated research questions, which is perceived as a weakness of SLRs (Grant & Booth, 2009; Okoli & Schabram, 2010). For instance, Boell and Cecez-Kecmanovic (2015b) indicate that SLR protocols do not eliminate the researcher’s subjective selection of literature, nor do SLRs guarantee comprehensive coverage of relevant literature.

Additionally, the difficulty in technology-related research is the inconsistency with which terms are used in IT and the profusion of technology-related terminology used in different publications and across disciplines (Pretto & Curró, 2017). For instance, if one considers the term eModeration, many scholars describe eModeration in varying contexts. Salmon (2004) and Gregory and Salmon (2013) describe an eModerator as a facilitator who mediates digital forums. Interactions between participants take place exclusively via networking technologies. The eModerator stimulates “human interaction and communication through the modelling, conveying and building of knowledge and skills” (Salmon, 2004, p. 4). eModerators are portrayed as “champions who make the learning come alive” (Salmon, 2004, p. 12). Furthermore, Salmon (2004), Gregory and Salmon (2013), Wright (2015), and Hoyos and Cano (2016) describe eModeration as implementing specific skills that establish an instructor’s presence in an online environment to manage collaboration between online tutors and their students.

Researchers have advocated various ways in which eModeration can be conducted. Adie (2009) focuses on the use of online moderation meetings as a means for educators separated by geography to achieve consistency in their evaluations. Subsequently, Adie (2011), expanded the concept of online moderation meetings by placing technology in the role of facilitating communication between educators engaged in assessment standardization. In contrast, Van Staden et al. (2017), describe eModeration as utilizing an online tool for digital quality assurance. A digital moderation system provides a user interface for scanning paper-based assessments and enables the moderator to adjust marks or provide comments using digital tools. The modified assessment can then be uploaded and is digitally accessible to the original assessor (Van Staden et al., 2017).

The broad usage of terminology leads to a vast number of journals being generated, which calls for selective use of appropriate key terms by the researcher (Boell & Cecez-Kecmanovic, 2015a; Pretto & Curró, 2017). To make a unique contribution to the body of knowledge, one initially needs to read broadly, and thereafter read more specifically and be more focused. The search process becomes complex due to the combination of the need for broad reading and the extensive IT-related terminology (Pretto & Curró, 2017).

It is important that the literature review clearly records the steps used in its development. By adhering to this procedure, SLRs provide a "standardized method" for conducting replicable, clear, impartial, balanced, and rigorous literature reviews (Okoli & Schabram, 2010; Boell & Cecez-Kecmanovic, 2015b, p. 161; Paré et al., 2015).

## 2.4. Literature Review Protocol

Consistent with the views expressed by Paré et al. (2015), Pretto and Curró (2017) recommend a methodological approach of managing the complex body of knowledge using the following five steps. These steps, together with their operationalization in this study, are outlined in the following sections.

**Step 1: Begin from the general to the specific**

A keyword search refers to the "querying of quality scholarly databases by the use of a specific word or phrase (i.e., "keyword") when attempting to find relevant literature" (Ellis & Levy, 2006, p. 190). Pretto and Curró (2017) suggest that the researcher should begin by using a wide variety of search terms. Additionally, for a rigorous review, it is necessary to develop rules that clearly specify the inclusion and exclusion criteria for choosing and evaluating specific articles (Boell & Cecez-Kecmanovic, 2015b).

Familiarity with the resources of multidisciplinary, specialist databases increases researchers' opportunities of conducting systematic and thorough searches (Gasparyan et al., 2016). Google Scholar is often used as a starting point for preliminary searches due to its multi-disciplinary platform (Gasparyan et al., 2016). However, it has limitations such as low specificity in finding relevant primary sources, lack of quality control, and limited functionality for systematic searches (Gasparyan et al., 2016). To overcome these limitations, and given Ellis and Levy's (2006) emphasis on the importance of expanding the search beyond a given vendor, additional searches were performed using databases such as Web of Science (WoS), Inspec, and Scopus, which provide better indexing and bibliographic records (Cavacini, 2015).

Okoli and Schabram (2010) highlight the need to be selective in evaluating information found on the Internet. Some online publications may not meet quality standards, so it is important to verify the credibility of sources. Accordingly, Harzing's Publish or Perish (Windows GUI Version 7), which uses various data sources to gather and analyze citations, was used in this study to broaden the data search. To ensure the retrieved publications were from credible sources, the search results were sorted in descending order of the number of citations. The abstracts of the articles provided a basis to eliminate those that did not meet the exclusion criteria (see **Table 2-1**).

**Step 2: Scan and survey all technology related journals and books**

The next step is to scan and survey all recent technology-related articles to create references that could be further categorized using more precise search phrases. Scrutinizing the title and abstract is imperative at this stage. It was important not to discard articles that were written at different levels, as these references might lead to additional relevant sources (Pretto & Curró, 2017).

In this study, only relevant articles based on the title and abstract were saved to Mendeley for further perusal. The remaining articles were eliminated from further consideration due to their focus on facilitating online discussions in a computer-generated learning environment. The predominant focus of the retrieved articles was documented.

Ellis and Levy (2006) caution that limiting search terms may hamper the ability to obtain sources beyond normal search parameters. Hence, a wide range of search terms was used (see **Table 2-1**) to ensure that relevant journals were found. For instance, New-Zealand-Qualifications-Authority (2016b) mentions a digital moderation project. A Google search using the keywords "digital moderation project+New Zealand qualification authority" produced newspaper articles about the cloud-native digital moderation project in New Zealand schools. However, searches on Scopus, Inspec and WoS using the keywords: "cloud-native digital moderation" yielded no results. The only pertinent studies on digital moderation are illustrated in **Table 1-1**.

Additionally, it is important to move beyond keywords and use backward and forward search approaches as recommended by Ellis and Levy (2006) and Jalali and Wohlin (2012). Backwards reference search involves reviewing references from articles obtained from the initial keyword search. For instance, a related article was found from the reference lists of the initial four articles in this study by using the search phrase "user experience evaluation moderation systems". Keyword searches were repeated for each database used, and the resulting literature was isolated for further perusal.

A forward reference search involved a review of the articles that cited a specific article (Ellis & Levy, 2006). For instance, repeated searches using different phrases produced articles by the same authors. By using the cited by feature of Google Scholar, additional articles were sourced.

**Step 3: Refine the selection**

Ellis and Levy (2006) and Pretto and Curró (2017) concur that reading the entire article is important because the title and abstract do not necessarily provide a clear understanding of its content. Boell and Cecez-Kecmanovic (2015b) suggest examining each journal for methodological rigour and the reliability of the findings to determine which evidence to include or exclude. In line with these suggestions, the selected articles for analysis were saved to

Mendeley. The complete articles were read, and the highlighting tool was used to accentuate the relevance and value of the content. Articles about systems that were not specifically focused on digital tools in education were eliminated. Relevant articles were added to favourites in Mendeley for easy identification during the literature review. Additionally, the reference list of each article was analyzed to identify key authors in the field (Pretto & Curró, 2017), and their names were used as search terms in the author field of Harzing's Publish or Perish to source additional articles.

**Table 2-1: Exclusion and Inclusion Criteria**

<table>
<tr><td colspan="8">SEARCH TERMS</td></tr>
<tr><td>eModeration</td><td>digital moderation</td><td>Moodle in digital moderation</td><td>Digital moderation +education</td><td>ICT + moderation</td><td>Effectiveness of digital moderation</td><td>eAssessment technology</td><td>ICT systems+ external moderation</td></tr>
<tr><td>quality assurance +online learning</td><td>digital moderation of assessments</td><td>Use of Moodle for external moderation</td><td>Online moderation</td><td>Digital external moderation</td><td>Education technology adoption</td><td>digital platform for external moderation</td><td>Online moderation + external assessments</td></tr>
<tr><td rowspan="2">INCLUSION CRITERIA</td><td>Language</td><td colspan="3">Type of literature</td><td colspan="2">Custom dates</td><td>Unit of Analysis</td></tr>
<tr><td>English</td><td colspan="3">conference proceedings; peer-reviewed journal articles</td><td colspan="2">2000 – 2022</td><td>moderation in HEIs</td></tr>
<tr><td>EXCLUSION CRITERIA</td><td colspan="2">Different domain (other than education)</td><td colspan="3">eLearning systems not focused on moderation</td><td colspan="2">Moderation of online forum discussions</td></tr>
<tr><td colspan="8">DATABASES: Web of Science, SCOPUS, Inspec</td></tr>
</table>

### Step 4: Read the selected sources with careful attention to IS terms used

Pretto and Curró (2017) recommend that the researcher pays close attention to the consistency of ICT terminology usage in the selected material. This adds a necessary tier of rigour to the search process to accurately categorize the literature (Ellis & Levy, 2006). In this study, the context in which relevant terms were used was analysed, while highlighting relevant content in Mendeley to ensure a cross comparison among the studies (Pretto & Curró, 2017).

### Step 5: Cull and sort the selected texts

The terms related to eModeration were examined for uniformity and context. Common themes were identified to strengthen categorization. Selected pdf files were categorized into specific topics and saved in appropriately named folders, as recommended by Pretto and Curró (2017) to easily find them and avoid manual sorting.

Ellis and Levy (2006, p. 192) maintain that the search is almost complete when additional articles present common "arguments, methodologies, findings, authors, and studies." The 713 articles produced in the initial database search were filtered based on relevance to digital assessment, marking, and moderation (see **Figure 2-1**). Using Google Scholar's "cited by" and "related articles" features, an additional 28 articles were identified. Duplicates from Scopus, Web of Science, and Inspec searches were removed. The titles of the remaining articles were reviewed to determine their relevance. By applying the exclusion criteria (see **Table 2-1**), 125 articles were excluded, leaving 123 articles to be analysed in depth for relevance to the research topic and for their ability to answer the research questions. Articles that did not meet the eligibility criteria were discarded and the remaining 63 articles were imported into Mendeley.

## 2.5. Literature Review

The first stage of the two-stage literature review included a review of moderation and eModeration. The second stage focused on HCI, with search terms including usability, user experience, quality in use, and product quality. The literature review was conducted on different data sets for each stage. The flow of information during the phases of the literature review process is depicted in **Figure 2-1**.

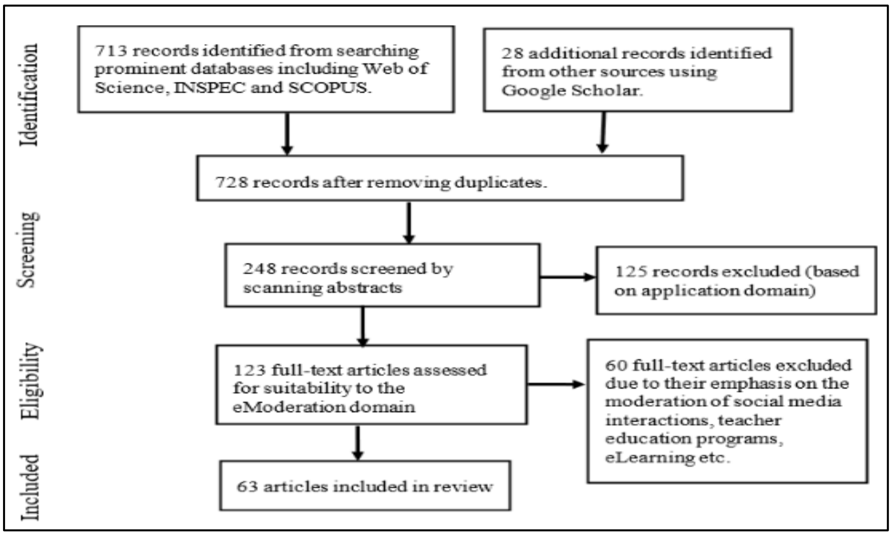



**Figure 2-1: Flow of Information through the different Phases of the Literature Review Adapted from Moher, Liberati, Tetzlaff and Altman (2009, p. 267)**

### 2.5.1. Literature Review of Moderation

This section outlines the literature review related to the moderation of assessments, beginning with an overview of what moderation is and a brief discussion of the importance of moderation, followed by a discussion of eModeration. This is followed by a discussion of the systems currently used in educational environments. This section concludes with a discussion of usability as applicable to an eModeration system and outlines the requisite components of an eModeration system. This literature review principally draws from the works of Adie (2009, 2010, 2011, 2012), Adie, Lloyd and Beutel (2013), Beutel, Adie, and Lloyd (2014), Bloxham (2009), Bloxham, Hughes, and Adie (2016), Klenowski and Wyatt-Smith (2010), and Adie and Klenowski (2016), who are recognized as specialists in moderation practices.

#### 2.5.1.1. What is moderation?

Moderation is the process of reviewing and adjusting the grading of assessments to ensure that they are fair, consistent, and accurate. This process is necessary to ensure that students are evaluated based on the same standards and that the evaluations are valid and reliable (Connolly, Klenowski, & Wyatt-Smith, 2012; Krause et al., 2013; Wyatt-Smith, Alexander, Fishburn, & McMahon, 2017; Williams, 2019).

Researchers have described moderation in various ways. Adie (2012) explains moderation in terms of a technology-mediated interaction among teachers from geographically dispersed areas. Adie and Klenowski (2016), Beutel, Adie, and Lloyd, (2017) and Gourdin et al. (2019) on the other hand, emphasize the physical communication between teachers when collaboratively developing assessment criteria. Thus, moderation is deemed to be a social, quality assurance activity to establish a shared understanding of standards among different assessors. Bloxham et al. (2016) specify different moderation practices and examine the purposes of moderation. In contrast, Adams and Anderson (2019) locate moderation as an efficient method of professional learning and accountability for teachers. According to Handa (2018), moderation is a process by which teachers communicate their knowledge and expectations concerning standards to improve the reliability of their judgement of students' learning. Krause et al. (2013) describe moderation as a process incorporating peer reviews to develop uniformity in assessment judgements.

Moderation, as defined by Maxwell (2010, p. 457), is a “process for producing consistency across assessors in qualitative judgments of student performance or achievement”. While moderation is important at individual institutions, Krause et al. (2013) highlight the importance of regulating standards of student achievement across HEIs and within common courses to allow inter-institutional judgements of student assessments. Inter-institutional moderation is acknowledged as a valuable approach to address challenges in creating effective and dependable assessments. Likewise, Gourdin et al. (2019), Handa (2018), Newhouse and Tarricone (2016), Teltemann and Jude (2019), and Wyatt-Smith et al. (2017) emphasise the importance of consistent standards that are subject to ongoing discussions, evaluation, and validation within educator communities. As a quality assurance process, moderation ensures that there is consistency amongst judgments of student assessments before they are reported on (Maxwell, 2010c).

In the SA context, assessment practices are governed by the SA Qualifications Authority (SAQA). SAQA describes moderation in assessment as the internal and external verification of the credibility of an assessment system, and that assessments are fair, valid, reliable, and practicable (SAQA, 2015). This description is in line with international definitions. Adams and Anderson (2019, p.13), for instance, describe moderation as an “activity to develop tasks and activities which provide learners with fair and valid opportunities to meet the standards and expectations required of them”.

Despite the disparate foci of the aforementioned studies, the commonality that has emerged is that moderation is a procedure for guaranteeing that awarded marks are impartial and reliable, and that marking guidelines are used consistently (Wyatt-Smith et al., 2010). Drawing on the works of Maxwell (2010), Beutel et al. (2017), Handa (2018), Dessai and Kamat (2018), SAQA (2015), and Vergés Bausili (2018), moderation can be explained as a quality assurance process where the moderator reviews the assessment judgements of the initial assessor and expresses their opinions on the grades, the uniformity of the grading and feedback provided by the assessor to align assessors’ judgements and promote a shared interpretation of the relevant standards.

#### 2.5.1.2. Rationale for moderation

Whilst research into moderation practises in secondary schools in SA is not extensive, several international studies claim generalisability in driving efforts at reforming the moderation process and increasing professional and quality standards (Maxwell, 2010; Colbert et al., 2012; Connolly et al., 2012; Wyatt-Smith et al., 2017). Notably, prevailing research is supportive of a standards-based paradigm, so as to improve quality standards (Connolly et al., 2012; Krause et al., 2013; Booth et al., 2016; Dessai & Kamat, 2018).

Beutel, Adie, and Lloyd (2017, p. 4) refer to "consensus" or social moderation when discussing the use of common frameworks by assessors when making judgements of assessment tasks. Social moderation is described as a process in which assessors work collaboratively to establish a common understanding of assessment standards (Adams & Anderson, 2019; Connolly et al., 2012; Newhouse & Tarricone, 2016; Williams, 2019). Social moderation can take the form of face-to-face peer moderation or online technologically mediated moderation forums. Teachers engage with moderation processes and a community of moderators, irrespective of where they are physically located, by asynchronous (e.g., email) and synchronous (e.g., video-conferencing) online systems (Newhouse & Tarricone, 2016).

Moderation has largely become a component of the cycle within the assessment process, evolving to integrate validation, monitoring educators' professional development, and most significantly accountability (Adams & Anderson, 2019). A study of 20 countries by Teltemann and Jude (2019) indicates that the use of external moderation as a method of quality assurance at schools is relatively widespread.

The literature suggests that moderation is a critical process in ensuring the quality and consistency of assessments, and that it plays an important role in establishing a shared understanding of standards among assessors.

#### 2.5.1.3. Moderation in the SA context

Moderation processes in the SA secondary school context are discussed in terms of exit examinations, the nature of school-based assessment and the moderation thereof, and the requirements for digital submissions of assessments.

#### 2.5.1.3.1. Exit examinations

In SA schools, Grade 12 is the exit point of the schooling system. As such, the Grade 12 curriculum is regulated by a national assessment and certification process. The Council for the Quality Assurance in General and Further Education and Training (UMALUSI) is a quality assurance body whose responsibility is to ensure that exit examinations are quality assured (Punt, 2010). The key quality assurance processes, as outlined by UMALUSI, are:

- Moderation of question papers as well as internal and practical assessments;
- Monitoring of the readiness to conduct, administer, and manage the writing and marking of examinations, verification of marking, and the reporting of irregularities;
- Discussions of marking guidelines;
- Managing concessions; standardisation, statistical moderation, and resulting.
- Approval of the release of results (Volmink, 2018).

#### 2.5.1.3.2. Internal School-Based Assessment (SBA)

In addition to exit examinations, internal assessment, also referred to as School Based Assessment (SBA), is fundamental in calculating the final results of students (Independent-Examinations-Board, 2015; Punt, 2010).

The National Curriculum Statement (NCS) promotes an assessment-led method for student learning, supporting the idea of assessment for learning together with an assessment of learning. Continuous assessment of learners during the school year underpins the implementation of the NCS (Independent-Examinations-Board, 2015). Valid, fair, and reliable evidence of learner performance against the requirements of the curriculum is gathered and recorded as evidence via the continuous assessment process (Independent-Examinations-Board, 2015). It is an NSC requirement that the standard and quality of SBAs must be quality assured to ensure uniform standards (Punt, 2010; IEB, 2020).

#### 2.5.1.3.3. Processes used at private schools for the moderation of SBA tasks

The IEB moderates SBAs using Regional Moderators (RMs) during the year and a national moderation process at the end of the academic year (Independent-Examinations-Board, 2015). RMs are allocated specific schools whose tasks are to be moderated. Prior to COVID, the IEB provided three different models that the RM could apply when moderating:

**Model 1:** A cluster of schools may be asked to send all files to a central school within their region. The moderator then travels to that school to moderate files.

**Model 2:** The moderator may ask schools to courier files to their school or a central venue.

**Model 3:** Schools courier files to the moderator. The moderator completes the moderation and couriers the files and moderator reports to the school (Independent-Examinations-Board, 2015).

Once moderation is complete, the RM provides the IEB and the teacher with a report on the standard and compliance of the files (Independent-Examinations-Board, 2015).

#### 2.5.1.3.4. Requirements for digital submission of assessments

The COVID pandemic necessitated an alternative to the initially proposed models. The IEB published requirements for digital submissions, indicating the use of the IEB Postbox system, with a caveat that the developmental work on the system is complete at the time that RMs would need to use the system. RMs could use “email, Dropbox or any other electronic communication system agreed to between the RM and the school”, provided that the integrity of the process is protected (IEB, 2020).

The IEB stipulates that learner files must be compiled in a format that is neither expensive nor bulky. Additionally, each subject teacher must submit a teacher's file of the assessment tasks (Independent-Examinations-Board, 2015). It is an IEB as well as an UMALUSI requirement that moderation reports must be produced to provide feedback to the various assessment bodies to inform future improvements (Volmink, 2018).

The following sections describe the purpose of an eModeration system and existing ICT systems relevant to eModeration.

#### 2.5.1.4. Purpose of an eModeration System

The shift towards digital assessments has highlighted the need for robust moderation processes that can adapt to the challenges of technology-mediated assessments. Vergés Bausili (2018) maintains that inconsistencies in assessment procedures can be triggered by limitations in IT tools, which underscores the importance of rigorous quality assurance processes. An eModeration system, as described within this study, provides the user with a digital interface to allow for the assessment and re-grading of marked assessments using digital means (Van Staden et al., 2019). Despite some limitations, such as the need for reliable and stable internet connectivity, the shift towards digital assessments has the potential to improve the efficiency and effectiveness of the moderation process (Van Staden, 2017).

#### 2.5.1.5. Existing studies and ICT systems relevant to eModeration

Existing studies/systems used specifically in eModeration are depicted in **Table 1-1.** These systems are described individually based on their salient features, including their application domain, their primary focus, and the features of the system (if any).

Booth and Rennie (2015) report on the first few phases of the trial of an online peer review tool (see **Table 1-1**) to improve the efficiency and consistency of assessment processes in HEIs. The focus of the study was on the consistency of assessments between two different reviewers. The online peer review tool served as a repository for assessments, and also as a tool for a comparison of the judgements made by individual assessors. The study only comprises the first two phases of a larger project and does not provide empirical evidence of the tool's implementation or usability.

Newhouse and Tarricone (2016) describe a system for pairwise comparison in social online moderation to assist secondary school teachers in creating a shared understanding of standards. The system serves as a repository for digital samples of student work. The predominant focus of this system is to support social online moderation by dynamically generating sets of digital tasks for individual assessors to judge. Assessors document their comments and scores, of which the system calculates and determines the reliability. Standardization discussions by teachers precede and follow the use of the system, and moderation takes the form of online scoring to reach a consensus, rather than reliance on the system to conduct the moderation process.

The Digital Moderation Project was to be rolled out in secondary schools. The focus was on eliciting teacher requirements to develop an online eModeration system (New-Zealand-Qualifications-Authority, 2016b). As indicated previously, no existing system could be found.

In the SA context, Van Staden (2017) describes an eModerate system that was successfully implemented and tested in two private HEIs. The focus of this study was on a framework for the evaluation of the user experience of the eModerate system. The eModerate system allows a moderator to securely retrieve scanned documents that have been uploaded to an online learning environment. Once the marked scripts have been moderated, the moderated assessments are uploaded for the initial assessor to download, and stakeholders receive notification when the moderation has been completed.

Dessai and Kamat (2018) present a system for use in the public examination system. The focus of this sytem is on implementing machine language to determine the quality of an assessment and to establish consistency in evaluation. The system classifies the evaluations carried out by each examiner as either negligent or normal. Artificial Neural Network (ANN) modelling is used to predict a mark as though one examiner had performed all evaluations, thus controlling inter-examiner variations in appraisals.

#### 2.5.1.6. Requirements of an eModeration system

Requirements form the basis of all software systems, thus playing a significant role in system development (Schön et al., 2017). In this study, requirements are not described in terms of IS system requirements as defined in literature, namely, as the "*condition or capability that must be met or possessed by a system, system component, product, or service to satisfy an agreement, standard, specification, or other formally imposed documents"* (ISO-IEC, 2018). According to the Merriam-Webster dictionary (Available from: https://www.merriam-webster.com/dictionary/requirement; [Accessed: 18/10/2022]), requirements can be defined as: "something wanted or needed" and criteria can be defined as "a standard on which a judgement or decision may be based". In this study, requirements are defined as the functional and design expectations that users have of a system, while criteria are standards that are used to make adoption decisions. **Table 2-2** depicts the functional requirements of potential users of an eModeration system. The user, task, and system are identified as components of an eModeration system (see **Figure 1-3**), with the system representing the technology.

A previously conducted study (see Rajamany et al., 2020b) groups the requirements for an eModeration system into three main categories: user requirements, task requirements, and system requirements.

User requirements are aspects of the eModeration system that have a direct impact on the users. Task requirements are the elements of the system that are necessary for users to be able to complete eModeration tasks. This can include functionalities such as the ability to upload and retrieve assessment documents, access to moderation tools, and collaboration features. System requirements refer to the fundamental characteristics of the eModeration system that are critical to its effective implementation.

By understanding these different requirements, the eModeration system can be designed and developed to meet the needs of its users, support effective eModeration tasks, and ensure its successful implementation. In the secondary school environment, typical users would be teachers who could take on the role of an assessor or a moderator. The assessor would upload either an assessment task or an assessed task. The moderator would use the eModeration system to access the uploaded assessment, use the annotation tools to indicate their agreement or disagreement with the allocation of scores and comment on the standard of marking or development of an assessment. The moderator has the option of selecting from a pre-defined list of generic comments or adding their own comment. Moderator feedback would be available to the teacher via the digital eModeration system. The eModeration system would thus facilitate a seamless interaction between the teacher and moderator while also providing proof of moderation.

The requirements for an eModeration system, as reported in Rajamany (2020), were synthesized from a literature review, participant responses to an online questionnaire (N = 64), and participant responses in a focus group consisting of moderators and teachers. These elements were categorized and reflected as a conceptual model, as illustrated in **Figure 2-2**.

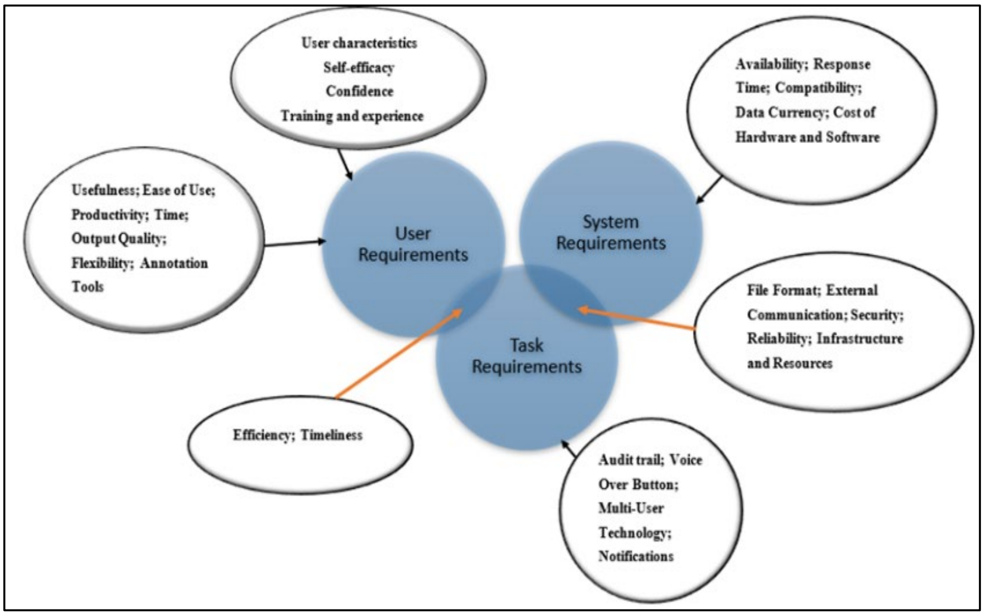



**Figure 2-2: Conceptual model**

The requirements have been categorized under User Requirements, Task Requirements, and System Requirements, as depicted in **Table 2-2**.

**Table 2-2: Requirements of an eModeration system**

| **User Requirements** | | **Task Requirements** | **System Requirements** | |
|---|---|---|---|---|
| Usefulness<br>Ease of use<br>Productivity<br>Output quality<br>Flexibility. | Self-efficacy<br>Confidence<br>Training and experience. | Audit trail<br>Efficiency<br>Timeliness<br>Multi-user technology<br>Notifications<br>Voice-over button. | Availability<br>Response time<br>Compatibility<br>Data currency<br>Cost saving. | External Communication<br>Security<br>Reliability<br>Infrastructure and resources. |

### 2.5.2. Review of Human-Computer Interaction

This section provides a broad overview of the field of Human-Computer Interaction (HCI). The two fundamental principles of HCI, namely, usability and user experience, are defined as applicable to IS generally. A discussion of the relationship between usability and user experience and their specific applicability to the eModeration context is presented. The related concepts of quality in use and product quality are presented to obtain a comprehensive set of constructs to evaluate the UX of an eModeration system.

### 2.5.3. Human-Computer Interaction

HCI researchers observe how humans interact with computers, in addition to designing technologies that allow humans to creatively interact with computing technology (Fielding et al., 2008; Fischer, 2001). Sallé (2004) identifies seven criteria used to commonly describe what an organization requires from IT. These criteria, depicted in **Table 2-3,** are incorporated into the field of HCI.

**Table 2-3: Criteria for IT systems (Sallé, 2004)**

| Criterion | Definition |
|---|---|
| Effectiveness | Information is applicable and relevant to the organization and provided in a timely, correct, consistent, and usable manner. |
| Efficiency | The optimal use of resources in provisioning information. |
| Confidentiality | Protecting confidential data from being illegally disclosed. |
| Integrity | Accuracy and completeness of information. |
| Availability | Information is available when required. |
| Compliance | Conforming to regulations, laws, and contractual agreements. |
| Reliability | Provisioning of suitable information for managers to manage the entity and implement its financial and compliance reporting obligations. |

The aim of HCI research is to make systems more usable and useful while providing users with context-specific experiences (Fischer, 2001). The typical HCI approach to evaluating IS for human use focuses on usability (Dillon, 2002), which is discussed in the following section.

#### 2.5.3.1. Usability

When creating IT systems, developers strive to design systems that are easy to use. Terms such as “user friendly” and “easy to use” are often used to specify these features, but the general technological term is “usability” (Petrie & Bevan, 2009). Usability is a core term in HCI, with varying definitions being provided in the literature.

#### 2.5.3.2. Definitions of usability

Despite differing viewpoints and descriptions of usability, there is agreement that usability is context-bound and shaped by the interaction between the type of task, the person using the system, and the type of use (Dillon, 2002). Usability encompasses attributes of a system that make it understandable, learnable, easy to use, and attractive (Hornbæk, 2006; Hedegaard & Simonsen, 2013; Weichbroth, 2020). Numerous definitions of usability (see **Table 2-4)** have been proposed by various authors.

**Table 2-4: Usability definitions**

| Author | Usability definition | Constructs |
|---|---|---|
| Nielsen (1993, 1996) | Usability refers to how well users can use the system's functionality. | Learnability<br>Efficiency<br>Memorability<br>Errors<br>Satisfaction |
| Lee (1999) | Usability is concerned with making computer systems easy to learn and easy to use through a user-centred design process. | Ease of learning<br>Ease of use<br>Easy to remember<br>Effectiveness<br>Few errors<br>Flexibility<br>Satisfaction |
| Bevan (2001) | Usability is defined as "quality in use" and refers to the capability of the system to be understood, learned, used and attractive to the user, when used under specified conditions. | Understandability<br>Learnability<br>Operability<br>Attractiveness |
| Nielsen (2012). | Usability is a quality attribute that assesses how easy user interfaces are to use. The word "usability" also refers to methods for improving ease-of-use during the design process. | Learnability<br>Efficiency<br>Memorability<br>Errors<br>Satisfaction |
| Bevan et al. (2016). | "achieving predetermined practical goals"; "the degree to which a product or system can be used with effectiveness, efficiency, satisfaction and freedom from risk in both specified contexts of use and contexts beyond those initially explicitly identified". | Learnability<br>Effectiveness<br>Efficiency<br>Satisfaction<br>Freedom from risk<br>Flexibility |
| Weichbroth (2020). | Usability is a "study of the intersection between systems and users, tasks and expectations in the context of use". | Learnability<br>Effectiveness<br>Efficiency<br>Memorability<br>Errors<br>User satisfaction<br>Simplicity<br>Comprehensibility<br>Learning performance |

Drawing on the definitions provided in **Table 2-4**, usability refers to the ease of use of a system, and is defined as a measure of how effectively and efficiently a user can achieve practical goals with satisfaction in the specified context of use. The interaction between the user, task, and system and the intersection of this interaction and the context of use is an important aspect of this definition (Bevan, 2001; Bevan et al., 2016); it highlights the importance of considering the user, their goals, and the context of use when evaluating the usability of an IT system. Usability is relevant to three areas as outlined by the ISO-IEC (2018) standards, namely:

- Regular ongoing use: to allow users to achieve their goals effectively and efficiently and with satisfaction when using the eModeration system;
- Learning: to empower inexperienced users to be effective, efficient, and satisfied when starting to use the eModeration system; and
- Infrequent use: to allow users to be effective, efficient, and satisfied with each reuse of the eModeration system.

Usability relates to a system's functionality and is a significant attribute of interactive systems (Ferreira et al., 2020; Madan & Dubey, 2012). User evaluation is therefore essential for ensuring system quality.

While usability has historically been associated with realizing prearranged practical aims, the definition has been expanded to include the achievement of personal outcomes (Bevan et al., 2016). Computer use should provide the appropriate functionality for users to complete their tasks, and should offer both usability and reliability (Pfleeger et al., 2015). Dillon (2002) suggests an emphasis on the following three aspects of users' interactions with IT systems:

- Process: what the user does;
- Outcomes: what the user achieves; and
- Affect: what the user feels.

Usability, as part of a detailed software design activity, is a way of measuring a system's ability to assist a user to adequately solve a given task (Hedegaard & Simonsen, 2013). A holistic measure for evaluating an IS should consider the impact and quality of the system (Gable et al., 2008). McNamara and Kirakowski (2006) advise that usability measurements should be centred around the definition of usability as quality in use as advocated in the ISO standards.

#### 2.5.3.3. Usability as Quality in Use

The ISO standards for software quality refer to usability as quality in use, which highlights the user's overall experience of the quality of the system ( Petrie & Bevan, 2009; ISO-IEC 25010, 2011; ISO-IEC, 2018). In this context, usability is regarded as a part of the software design process to ensure that the software meets the user's needs (Bevan, 2001). The notion of "user-perceived quality" relates quality to the needs of the user, thus moving the focus of quality from the system in isolation to the users, the tasks, and the context of use (Bevan, 1995, p. 118). Thus, different results are produced based on the user's perceptions of the interface (Muhammad & Muhammad, 2010).

The ISO-IEC 25010 (2011) defines system quality as "the degree to which the system satisfies the stated and implied needs of its various stakeholders, and thus provides value". System quality has two major dimensions:

- Quality in use specifies the attributes associated with a person's interaction with the system.
- Product quality specifies the fundamental product attributes (Atoum et al., 2014).

Not only is quality in use determined by the quality of the software, hardware, and operating environment, but also by the features of the people using the system, the task being carried out, and the social environment (Bevan, 1995). The quality in use model proposed by the ISO-IEC 25010 (2011) standard consists of five characteristics associated with the result of a user's interaction with a system. These characteristics are mapped to eModeration requirements (see **Table 2-5**).

**Table 2-5: Quality in Use Characteristics**

| Characteristic | Definition | eModeration Requirement | Component of ISO Definition? |
|---|---|---|---|
| Effectiveness | Accuracy and completeness with which users accomplish specific objectives (ISO-IEC 25010, 2011). | System requirement. | yes |
| Efficiency | Resources utilized concerning the accuracy and completeness with which users accomplish their objectives (ISO-IEC 25010, 2011). | User requirement. | yes |

| Characteristic | Definition | eModeration Requirement | Component of ISO Definition? |
|---|---|---|---|
| Freedom of risk | The extent to which a system alleviates the possible risk to financial status, human life, or the environment (ISO-IEC 25010, 2011). | N/A. | yes |
| Satisfaction | The extent to which the user's needs are satisfied by system use in a particular context (ISO-IEC 25010, 2011). | User requirement. | yes |
| Context coverage | The extent to which a system can be used with effectiveness, efficiency, freedom from risk, and satisfaction in specified environments and settings beyond those originally identified (ISO-IEC 25010, 2011). | N/A. | yes |
| Flexibility | The degree to which the system can adapt to changes required by users, outside of those initially specified (Petrie & Bevan, 2009). | User requirements | no |
| Learnability | The time and effort necessary to attain a specific level of system performance (Petrie & Bevan, 2009). | User requirements | no |

Petrie and Bevan (2009) include flexibility and learnability as aspects of usability, although these terms are not components of the original ISO definition (see **Table 2-5**). Based on the assertion that for the end user not only are there pragmatic task-related goals, but also hedonic goals (Hassenzahl, 2004), the user experience becomes a key feature in establishing the quality of a product (Díaz-Oreiro et al., 2019).

### 2.5.3.4. User Experience

Hassenzahl and Tractinsky (2006) describe UX as a result of a user's internal state, the features of the system, and the environment within which the user's interaction with the system occurs. The physical technology and task environment are contextual factors affecting user experience (Law et al., 2009). Considering that UX is dynamic, subjective, and context-dependent, Schrepp et al. (2017) recommend that UX be considered during the product's design.

### 2.5.3.5. Definitions of user experience

Various definitions of UX are depicted in **Table 2-6**.

**Table 2-6: Definitions of UX**

| Author | UX definition |
|---|---|
| Thüring and Mahlke (2007, p. 29). | User experience is exclusively concerned with the user's perception of a system's usability. |
| Norman and Nielsen (2008). | UX incorporates all aspects of the users' interaction with the product. |
| Roto & Kaasinen (2008, p. 572). | UX describes the "user's feelings towards a specific product, system, or object during and after interacting with it". |
| ISO-IEC (2018)[2]. | "User's perceptions and responses that result from the use and/or anticipated use of a system, product, or service". |
| Law et al. (2009, p. 727). | User experience is related to usage and focuses on the "interaction between a person and something that has a user interface". |
| Hassenzahl et al. (2010, p. 353). | "UX is a dynamic, highly context-dependent, and subjective account of human–technology interaction". |
| Obrist et al. (2010, p. 3198). | "User experience (UX) explores how users feel about using a product, i.e., the affective aspects of product use". |
| Vermeeren et al. (2010, p. 521). | "User experience explores how a person feels about using a product, i.e., the experiential, affective, meaningful, and valuable aspects of product use". |

Drawing on the definitions provided in **Table 2-6,** UX can be described as a holistic approach to understanding all aspects of a user's interaction with an information system and the experiences that arise from that interaction, ranging from their emotions to their understanding of how the system functions and fulfils their expectations (Hassenzahl & Tractinsky, 2006).

### 2.5.3.6. Relationship between usability and user experience

There are varying viewpoints on the correlation between usability and user experience and there does not appear to be a consensus on whether UX is a characteristic of usability or vice versa (Lew et al., 2010; Moczarny et al., 2012; Hedegaard & Simonsen, 2013; Kashfi et al., 2019). Their specific definitions and allocation into dimensions such as efficiency, hedonic quality, and others are widely debated (Hedegaard & Simonsen, 2013).

[2] The ISO/IEC standards providing terminology do not have page numbers.

Some researchers propose that UX incorporates usability and is more comprehensive than usability (Rubinoff, 2004; Blythe et al., 2007; Tan et al., 2013; Rusu et al., 2015; Hassan & Galal-Edeen, 2017; Rose et al., 2017), while others argue that user experience is a measure of usability (Petrie & Bevan, 2009). Still others propose that user experience and usability are separate but closely related entities (Hassenzahl, 2007; Moczarny et al., 2012). Petrie and Bevan (2009) suggest that satisfaction is the subjective element of usability; hence, user experience can be considered a general term for satisfaction. This perspective views usability as including user experience. Studies that indicate these varying viewpoints are depicted in **Table 2-7**.

**Table 2-7: Relationship between usability and user experience**

| **UX incorporates usability and is more comprehensive than usability** | **User Experience is a measure of usability** | **User experience and usability are separate but closely related.** |
|---|---|---|
| Rubinoff (2004). | Desmet and Hekkert (2007). | Hassenzahl (2007). |
| Rusu et al. (2015) | Petrie and Bevan (2009). | Moczarny et al. (2012). |
| Blythe et al. (2007). | | |
| Hassan and Galal-Edeen (2017). | | |
| Rose et al. (2017). | | |
| Tan et al. (2013). | | |

While usability is an attribute of the interaction between the user and the system, UX considers the broader association between the system and the user (McNamara & Kirakowski, 2006). Usability is considered as a prerequisite for a good UX, yet is different from UX (Kashfi et al., 2019). Hassenzahl et al. (2010) and Kashfi et al. (2019) identify five unique characteristics of UX that differentiate it from usability. UX is:

- Subjective: UX relies largely on human perception;
- Holistic: UX includes hedonic as well as pragmatic aspects of use;
- Dynamic: UX changes over time;
- Context-dependent: UX is situated in context; and
- Worthwhile: UX incorporates positive and meaningful effects of use.

Delivering a good UX requires considering user expectations and delivering satisfaction by providing unexpected qualities (Kashfi et al., 2019). The perceived qualities of an interactive system can be separated into pragmatic (do goals) and hedonic (be goals) attributes to define key elements of UX (Hassenzahl, 2004, 2007; Hassenzahl et al., 2010; Hassenzahl & Tractinsky, 2006; Lew et al., 2010). These attributes are described below.

- Pragmatic attributes refer to the ability of the system to cater to the task-related needs and behavioural goals (usability) of users (Hassan & Galal-Edeen, 2017). The focus is on the system's utility and usability in completing tasks that are regarded as the "do-goals" of the user, which is equivalent to a general understanding of usability as "quality in use" (Hassenzahl, 2007, p. 10; Hornbæk, 2006, p. 79).

- Hedonic attributes refer to the system's ability to satisfy the non-task-related needs of the user (Hassan & Galal-Edeen, 2017). The focus is on the user. The hedonic quality of a system refers to an assessment of a system's ability to support the realisation of ''be-goals" (for instance an increase of knowledge and skills) for the user (Hassenzahl, 2004, 2007; Hassenzahl & Tractinsky, 2006; Hassenzahl et al., 2010).

Hassenzahl (2003) views pragmatic and hedonic attributes as independent of each other and argues for the consideration of both attributes in the design of interactive systems. Although the achievement of be-goals is the driver of user experience, an inability to complete do-goals may prevent the achievement of be-goals (Hassenzahl, 2008). In essence, user experience arises from the fulfilment of be-goals, which are facilitated by do-goals.

Usability focuses only on pragmatic quality aspects, while UX includes pragmatic and hedonic aspects together with user emotions that result from the interaction between the user and the system. User satisfaction can be measured by the extent to which users have achieved their pragmatic and hedonic goals (Bevan, 2008). Thus, the UX is influenced by the satisfaction of both usability in use (pragmatic goals) and satisfaction in use (hedonic goals) (Lew et al., 2010).

Effectiveness and efficiency are emphasized in usability, while UX emphasizes hedonic and pragmatic characteristics (Roto et al., 2009). Thus, user experience seeks to examine a person's subjective experience of using the system, by focusing on the user's well-being as a result of his/her interaction with the system rather than on the performance of the system itself

(Moczarny et al., 2012); in contrast, usability is focused on ensuring that the system design satisfies user requirements (Grinberga, 2016).

Considering the various definitions of usability (see **Table 2-4**) and the ambiguity regarding a clear boundary between usability and user experience and, in line with Hassan and Galal-Edeen's (2017) assertion that usability is a user experience measure, the stance taken in this study is to regard UX as the overarching concept that includes usability. Subsequent discussions are therefore centred around usability as a subset of UX. Given this position, the terms usability and UX are used interchangeably in the remainder of this thesis.

Having considered Technology Acceptance Models (see **Table 1-2**), IS Success Models, and the field of HCI in Chapter One, the components identified from each of these areas are illustrated in **Table 2-8.**

**Table 2-8: Components identified from Technology Acceptance, HCI and IS models**

| | **Components** | **Constructs** | **Reference** |
|---|---|---|---|
| TAM | Human<br>System functionality. | Perceived ease of use, perceived usefulness. | Tarhini et al. (2015); Venkatesh et al. (2003, 2013); Venkatesh and Davis (1996, 2000). |
| UTAUT | Human<br>Social factors. | Effort expectancy, facilitating conditions, performance expectancy, social influence. | Hariyanti et al. (2018); Pynoo et al., 2011); Ramayasa, 2015). |
| TOE | Technology<br>Environment<br>Organization. | Compatibility, complexity, competitive pressure, external ICT support, ICT experience, industry, management support market scope, observability, organisational readiness, relative advantage, size, trialability. | Borgman, Bahli, Schewski, and Heier (2013); Ramdani, Chevers, and Williams (2013); Gangwar, Date, and Ramaswamy (2015). |
| TTF | Technology characteristics<br>Task characteristics<br>Individual characteristics. | Effectiveness, efficiency, individual impact, quality. | Dishaw and Strong (1999); Lai (2017); Wu and Chen (2017). |
| HOT-Fit | Human<br>Technology<br>Environment. | Environment, information quality, satisfaction, service quality, system use, system quality, user structure of organization. | Hariyanti et al. (2018); Muslimin et al. (2017); Papazafeuropoulou et al. (2008). |
| HCI | Usability (quality in use)<br>User experience (task environment, physical technology, user)<br>Product quality. | Ease of learning, effectiveness, efficiency, flexibility, user satisfaction. | Bevan et al. (2016); Grinberga (2016); ISO-IEC 25010, 2011); Lew et al. (2010); McNamara and Kirakowski (2006); Moczarny et al. (2012). |

| | Components | Constructs | Reference |
|---|---|---|---|
| IS Success model | Functionality<br>Content<br>Usability. | Information quality, net benefit, service quality, system quality, use, user satisfaction. | Petter et al. (2008); Petter and McLean (2009); Ramirez-Correa et al. (2016). |

The user, task and technology are components common to Technology Acceptance Models, the field of HCI, and IS Success Models (see **Table 2-8**).

## 2.6. UX criteria extracted from the literature

Having mapped the quality in use characteristics (see **Table 2-5**) to the requirements of an eModeration system, the criteria of an eModeration system (see **Table 2-2**), as identified from literature (Rajamany et al., 2022), are mapped to the components of an eModeration system (i.e., the user, the task and the system), as depicted in **Table 2-9**.

**Table 2-9: Components and criteria of an eModeration system**

| User components | Task components | | System components | |
|---|---|---|---|---|
| Digital literacy<br>Ease of use<br>Satisfaction with functions<br>Self-efficacy<br>Training and experience. | Annotation Tools<br>Audit trail<br>Automatic updates<br>Built-in templates<br>Calendar<br>Checklist<br>Choose moderator<br>Customizable comments<br>Customized notifications<br>Environmentally friendly<br>Functional help<br>Instant feedback. | Live video chat<br>Multi-user technology<br>Online editing<br>Productivity<br>Progress bar<br>Reduced printing<br>Reminders of deadlines<br>Reporting<br>Shared folders<br>Technical support<br>Tracking<br>Voice-over button. | Accuracy<br>Availability<br>Capability<br>Centralized data storage<br>Compatibility<br>Completeness<br>Complexity<br>Cost-saving<br>Cross-platform<br>Data currency<br>Dependability<br>External communication<br>File formats<br>Flexibility. | Internet connectivity.<br><br>Infrastructure and resources<br>Legibility<br>Multi-user authentication<br>Web-based<br>Organized file structure<br>Output quality<br>Quick response<br>Reliability<br>Response time<br>Robust hardware<br>Security<br>Synchronization. |

The following section presents an outline of the eModeration system functionality related to the user experience.

## 2.7. eModeration system functionality related to UX

The UX of an eModeration system is evaluated by considering the following functional requirements:

- A secure login process for moderators, teachers, and school management;
- The facility for teachers to upload teacher and learner files, question papers, as well as internal and practical assessments;
- Annotation tools for the moderator to annotate the assessment;
- The facility for a moderator to produce a report on the standard of assessments and/or further recommendations; and
- The facility for teachers to access moderator reports.

Given the above-mentioned emphasis on the UX of the eModeration system, the following aspects related to moderation are outside the scope of this thesis:

- Monitoring of the readiness to conduct, administer, and manage the writing and marking of examinations, verification of marking, and the reporting of irregularities;
- Discussions of marking guidelines; and
- Managing concessions; standardisation, statistical moderation and resulting and an approval of the release of results (Volmink, 2018).

## 2.8. Conclusion

This chapter provided an overview of the systematic literature review process that was undertaken. System attributes were first considered from criteria that are generally regarded as attributes of IT systems, and thereafter from measures that are used to evaluate information systems in the field of HCI. Usability and user experience were discussed in terms of their applicability to the eModeration system. Usability is explained as quality in use in the eModeration context. This chapter culminated with an identification of high-level components of an eModeration system from which specific criteria were extracted, based on the requirements of an eModeration system identified from the extant literature. The following chapter compares the different technology acceptance models and maps the IS success dimensions to the identified eModeration requirements to determine their applicability to the eModeration context.

# Chapter 3: Theoretical Constructs

## 3.1. Introduction

Chapter Two outlined a literature review of moderation and the field of HCI, and outlined the requirements, components, and criteria for an eModeration system. The purpose of this chapter is to present the theoretical basis underpinning the development of this study. Before developing an eModeration evaluation framework, it was necessary to investigate the literature on theoretical artefacts that can be created when using a DSR design. Existing theoretical models and UX frameworks were investigated. Finally, through a combination of constructs from Technology Acceptance and IS success models that impact UX and the usability constructs selected for consideration, a theoretical framework for eModeration that best fits the purpose of this study was developed.

This chapter is positioned within the Change and Impact cycle of the DSR process. **Section 3.2** presents a description of the artefacts produced from the DSR process. **Section 3.3** outlines the differences between frameworks and models. Section 3.4 presents a discussion of Technology Acceptance Models in terms of their basic premises and applicability to the eModeration context. **Section 3.5** presents IS success models. **Section 3.6** presents a discussion of three existing UX frameworks. **Section 3.7** presents the theoretical framework underpinning the data collection and analysis methods employed in this study. **Section 3.8** presents a discussion of the usability constructs pertinent to the evaluation of an eModeration system. **Section 3.9** concludes this chapter.

## 3.2. DSR artefacts

As part of the design (build and evaluate) cycle of the DSR process (see **Figure 4-1**), various artefacts are created to address unsolved problems regarding specific user needs. These artefacts are assessed based on their efficacy in resolving these problems (Hevner et al., 2004; de Villiers, 2005). Brief definitions are provided for the artefacts:

- Criteria serve as concrete, quantifiable representations of constructs (Dew, 2011).
- Constructs refer to attributes of a category of entities within a particular domain". For instance, in the technology acceptance domain, the "class of things" would be individuals

utilizing IT and a construct such as "perceived ease of use" would be applied to this class (Weber, 2012, p. 7). Constructs specify the classification systems that outline problems and solutions, thereby enabling the creation of models (Hevner et al., 2004; Cleven, Gubler, & Hüner, 2009; Visser, 2017).

- Models depict the relationships among constructs in a problem domain (Venable & Baskerville, 2012). They provide simplified and abstract representations of aspects of real-world phenomena relevant to the study (Weber, 2012). Models establish a link between a problem and its solution, allowing exploration of the consequences of design decisions in the real world, thus enhancing the understanding of both the problem and its solution (March & Smith, 1995; Hevner et al., 2004; Cleven et al., 2009).

- Methods represent steps to be executed when solving specific problems (Hevner et al., 2004; Cleven et al., 2009; Visser, 2017).

- Instantiations embody tangible representations of constructs, models, or methods that allow researchers to examine theories in real-world scenarios. (Hevner et al., 2004; March & Smith, 1995; Offermann, Blom, Schönherr, & Bub, 2010; Venable & Baskerville, 2012).

- Frameworks, in software development, are defined as "a defined support structure" that organizes and guides software development projects (Tomhave, 2005, p. 9).

## 3.3. Frameworks and models

Frameworks are characterized as being created to address specific needs or concerns, while models are abstract representations lacking specific implementation details (Tomhave, 2005; Urbaczewski and Mrdalj, 2006). Models are utilized to create prototypes, which can then be used to test and mediate the fit between the context of use and interaction elements (de Villiers, 2005).

A theoretical framework provides a structure to summarize concepts and theories derived from previously tested and published knowledge. Researchers synthesize these concepts and theories to form the basis for analyzing and interpreting research data (Kivunja, 2018). A valuable theory clarifies the researcher's perspectives and highlights important phenomena, thereby explaining the relationships explored within the study (Maxwell, 2013; Crawford, 2019).

Many researchers, for instance Venkatesh, Morris, Davis, and Davis (2003); Tarhini, Arachchilage, Masa'deh, and Abbasi (2015) and Lai (2017) have reviewed existing technology acceptance theories and models focusing on task technology fit (Goodhue & Thompson, 1995), individuals' acceptance of technology (Venkatesh et al., 2003; Venkatesh & Davis, 1996), and the successful implementation of technology at the organizational level (Awa et al., 2016).

It is crucial to understand the evolution, developments, and modifications of various models and their limitations to establish a coherent understanding of current research in which to situate one's study (Tarhini et al., 2015). In constructing a robust framework for evaluating an eModeration system, it was necessary to consider the prevalent theoretical models in which this research could be situated. In a user-centred design process, it is imperative to consider teachers' attitudes and perspectives when designing an ICT tool (Schulz et al., 2015). Furthermore, assessing technology acceptance provides a means of determining teachers' intention to use new technology in their moderation practices (Scherer et al., 2018). Thus, a key question to answer is whether users will find the system acceptable and plan to use it. The following sections present five of the most widely used Technology Acceptance Models, selected for their versatility in various contexts of use and their ability to predict adoption decisions.

## 3.4. Technology Acceptance Models

The different models provide a variety of constructs and factors that are relevant to the adoption and use of technology, and understanding the similarities and differences between these models provides a foundation for a comprehensive evaluation of an eModeration system. Models considered are TAM, UTAUT, TOE, TTF, and HOT-Fit (Hariyanti, Giriantari, & Linawati, 2018; Scherer et al., 2019; Singh & Mansotra, 2019). Each of these models is presented by providing a description and purpose of the model, describing the basic premise of the model, outlining the limitations of the model, and presenting the constructs of the model that are relevant to the evaluation of an eModeration system.

### 3.4.1. TAM

The Technology Acceptance Model (TAM), the latest version of which is the TAM3 model (see **Figure 3-1**), has dominated the research field as one of the most commonly used models that describe usage intentions and actual technology use (Ritter, 2017; Scherer et al., 2018).

The basic premise of TAM is that the easier a system is to use, the more likely it will be that the user will use the technology. Conversely, if the system is not perceived to be useful, the user will not continue to use it, irrespective of how easy it is to use (Ritter, 2017; Ajibade, 2018).

The main limitations of TAM pertain to its focus on usage prediction, its fit with technology, the disregard of task characteristics, and the intrinsic motivation of the user and its generalizability to various contexts. These limitations are discussed in the following paragraphs.

While Behrend et al. (2011), Babaheidari and Svensson (2014), and Jeffrey (2015) provide evidence of the applicability of TAM to the educational field, TAM's focus on usage prediction rather than on the effects of individual differences and organizational factors on actual usage falls short of conceptualizing what it means to accept and integrate technology in classrooms (Rienties et al., 2016; Hamutoğlu, 2020; Singh & Mansotra, 2019; Taherdoost, 2018).

Researchers are unable to meta-analytically validate TAM because previous research focused on broad samples of the population as well as on numerous technologies, possibly resulting in inconsistent findings (Ritter, 2017; Scherer et al., 2018). While TAM may fit a certain type of technology well, it may fit other technology poorly (Ritter, 2017).

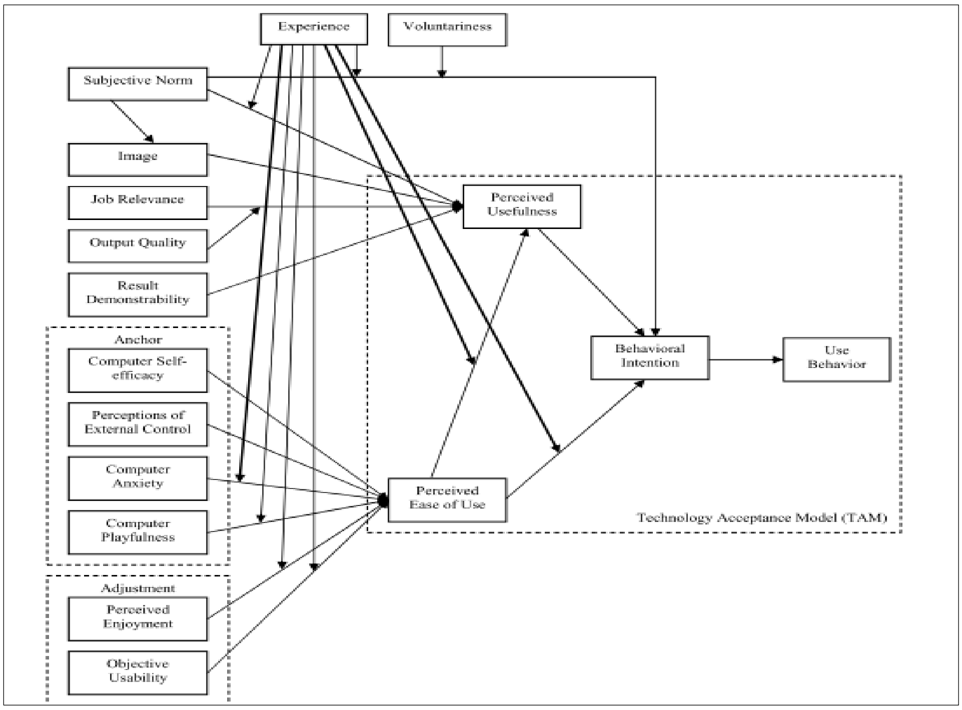



**Figure 3-1: TAM3 (Venkatesh and Bala, 2008)**

The disregard of task characteristics and how well the technology supports task requirements is a further limitation of TAM (Irick, 2008; Yen et al., 2010). For instance, while a system may be perceived as both useful and easy to use, TAM is less able to explain "whether or not the system provides the capabilities needed for the task" (Young & Lehto, 2013, p. 196). Chandio, Burfat, and Naqvi (2017) maintain that TAM does not sufficiently explain users' adoption of new technologies, as the factors affecting adoption are likely to vary with the system, context, and potential users.

TAM focuses solely on the user's perceptions of the ease of use of the technology (Mafunda et al., 2016). Although teachers' computer self-efficacy may explain variations in perceived usefulness and ease of use, conditions facilitating technology use vary and the external variables explaining variations in the core constructs differ (Scherer et al., 2019).

TAM does not address the intrinsic motivation of an individual to use an IT system (Taherdoost, 2018). Hence, the applicability of TAM to the user experience context, where the acceptance and use of an eModeration system to complete moderation tasks with satisfaction, may be limited.

The relevance of TAM to the evaluation of an eModeration system pertains to system functionality, ease of use, and the benefits arising from the use of the system, as explained below:

- System functionality: educators' acceptance of technology may vary depending on the type of technology being used (Ritter, 2017). The external variables of TAM thus present personal capabilities alongside contextual factors (Scherer et al., 2018), which is important in the eModeration context.

- The system's ease of use: presenting personal capabilities alongside contextual factors contributes to variations in ease of use and usefulness (Scherer et al., 2018). Anecdotal evidence points to the inclusion of computer self-efficacy as suitable for the evaluation of an eModeration system where technology use and skills amongst educators vary considerably.

- The benefits that may arise from the system's use (Tarhini et al., 2015): TAM's focus on attitudes towards the use of technology, rather than on performance measures such as effectiveness, lends itself to the evaluation of the UX of an eModeration system where the focus is on the users' subjective experience of their interaction with the system.

Despite its limitations, TAM continues to be widely used in the field of technology acceptance and its constructs, perceived ease of use, and perceived usefulness and remains relevant in the evaluation of eModeration systems.

#### 3.4.2. UTAUT

The UTAUT model measures the use and adoption of technology (Ain et al., 2015) and is largely accurate in predicting user acceptance of IT systems (Ain et al., 2015; Moran et al., 2010). UTAUT increases TAM's predictive capabilities by integrating human and social variables (Venkatesh et al., 2003; Rienties, Giesbers, Lygo-Baker, Ma, & Rees, 2016), with a focus on users who may be less willing to adopt and use new systems (Korpelainen, 2011).

The UTAUT model includes "performance expectancy, effort expectancy, social influence and facilitating conditions" as additional determinants of user acceptance of technology (Lai, 2017,

p. 33). UTAUT describes four core determinants of the user intentions and actual use of technology (Venkatesh, Morris, et al., 2003) (see **Figure 3-2**), the effects of which are moderated by users' gender, age, experience, and whether technology use is voluntary (Scherer et al., 2019).

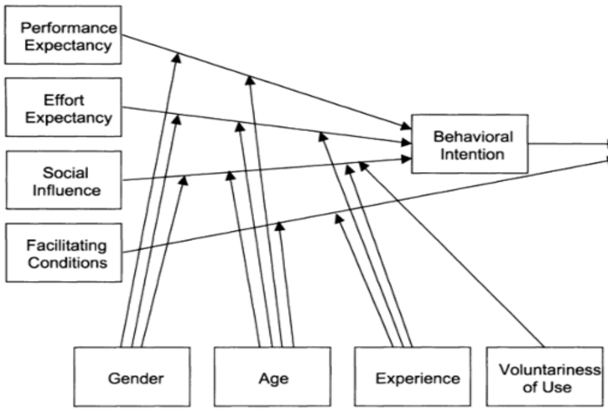



**Figure 3-2: UTAUT Model (Venkatesh et al., 2003)**

Although UTAUT examines the effects of the constructs on intention to use, a limitation is that the constructs do not connect to the actual usage of an IS (Hariyanti et al., 2018). Despite UTAUT's higher explanatory power and parsimony, UTAUT is criticized for not examining the direct effects of constructs that could potentially reveal additional relationships amongst them (Lai, 2017).

UTAUT's relevance to the evaluation of an eModeration system pertains to performance expectancy, effort expectancy, facilitating conditions, and experience. Performance expectancy indicates the degree to which the individual believes that system use will improve task performance. Thus, performance expectancy relates to the effectiveness with which goals are achieved. Effort expectancy relates to the ease of use of the system and refers to the extent to which individuals believe that technology use is effort free, thus speaking to efficiency (Kemp et al., 2019). Performance expectancy and effort expectancy are significant predictors of technology use (Lewis et al., 2013). The implementation of an eModeration system must take into account the facilitating conditions (context of use) and user experience to ensure that users are more likely to engage with it.

### 3.4.3. TOE

The Technology-Organizational-Environmental (TOE) framework (see **Figure 3-3**) is holistic and focuses on the technological, environmental, and organizational factors underpinning the acceptance of IS artefacts within organizations (Borgman, Bahli, Schewski, & Heier, 2013; Ramdani, Chevers, & Williams, 2013; Gangwar, Date, & Ramaswamy, 2015).

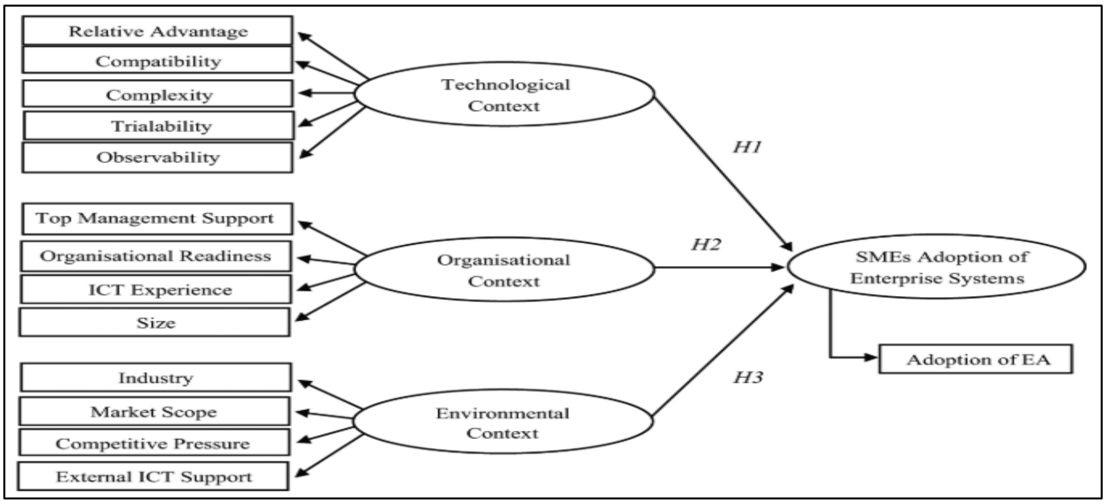



**Figure 3-3: TOE framework**

The basic premise of TOE is that technology–organization fit is a crucial factor in adoption decisions. The size and resources of the organization and the context within which the organization functions are important facilitators in adoption decisions.

A criticism of the TOE model is that it lacks a clear delineation of major constructs and that it is too generic (Ramdani et al., 2013; Gangwar et al., 2015; Singh & Mansotra, 2019). For instance, constructs are repeated in each of the human, organization, and technology characteristics. The lack of a clear demarcation of constructs could therefore create confusion as to which context is represented by that construct at any given time.

The TOE framework describes context from the perspectives of the technology, organization, and environment, which influences the adoption of technology (Singh & Mansotra, 2019). The construct of context is relevant and important to the evaluation of an eModeration system (see **Section 3.6.6**).

### 3.4.4. Task Technology Fit Model

The task-technology fit (TTF) model (see **Figure 3-4**) developed from a combination of the utilization focus, and task–technology fit research streams (Goodhue, 1998; Goodhue et al., 2000; Goodhue & Thompson, 1995) is extensively used in gauging the match between the task and technology attributes as a means of understanding the connection between IS and individual performance. TTF focuses on performance measurements (Wu & Chen, 2017).

A key characteristic of the TTF model is the extent to which the technology matches the task requirements and individual capabilities. The TTF model outlines three distinct characteristics, and presumes that performance effects are contingent on the alignment between these characteristics:

- Technology characteristics refer to "the technology used by individuals to perform their tasks" (Goodhue, 1995, p. 1828).
- Task characteristics refer to "the actions carried out by individuals in turning inputs into outputs" (Goodhue & Thompson, 1995, p.216).
- Individual characteristics include aspects such as training and computer experience, which influence how well a person is able to use technology (Goodhue & Thompson, 1995).

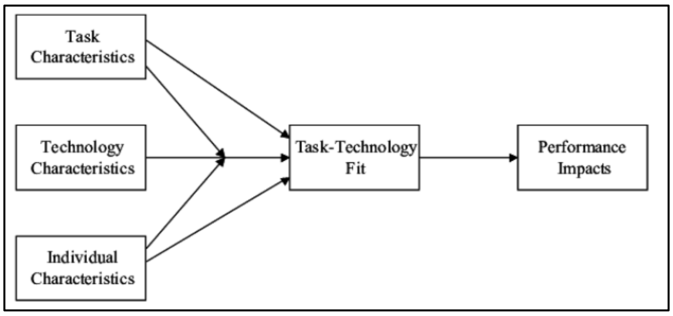



**Figure 3-4: TTF Model (Goodhue, 1995)**

The basic premise is that the better the fit is between these three characteristics, the more successful the technology will be in promoting individual performance (Goodhue, 1995; Irick, 2008). The fit between the tasks being performed and the technology's capabilities is crucial in determining user satisfaction and the likelihood of continued use (Yen et al., 2010).

A limitation of the TTF model pertains to its exclusive focus on the "fit" between user and task, and between task and technology. The importance of the fit between the user and organization and the fit between technology and organization are not considered (Mohamadali & Garibaldi, 2012). Additionally, the TTF model does not make provision for the inclusion of the context of use that will have a bearing on the usability of an IS (Rai & Selnes, 2019).

TTF does not include considerations to establish the effectiveness (namely the availability, capability, and dependability) of a system (see **Figure 3-4**) (Rai & Selnes, 2019). According to Rai and Selnes (2019), a focus on efficiency alone does not give a complete picture of the effect that fit has on adoption, as effectiveness is likely to have a greater impact on acceptance. An additional limitation of TTF is that it does not focus on social factors, which may restrict its predictive ability (Johnson et al., 2016; Rai & Selnes, 2019).

The greater the fit between the task and technology, the more efficiently users can complete tasks, thus resulting in improved satisfaction (Tripathi & Jigeesh, 2015; Yu & Yu, 2010). Similarly, specifically concerning an eModeration system, Van Staden (2017) argues that the success of the IS depends on content, usability, and functionality. Moderators need to be able to access information easily to complete their tasks efficiently. If users find the system useful, satisfaction increases (Wang et al., 2016).

### 3.4.5. HOT-Fit Framework

The HOT-Fit Framework (see **Figure 3-5**), founded on the DeLone and McLean IS Success Model and the IT-Organization Fit Model, is a rigorous model for evaluating the performance, effectiveness, and impact of an IS (Yusof & Yusuff, 2013; Erlirianto et al., 2015; Kilsdonk, 2016; Muslimin et al., 2017).

The HOT-Fit framework suggests that technology acceptance is influenced by the user, technology, and organizational context of use, and that the better the fit between these three components, the more effective the system will be (Muslimin, Hadi & Nugroho, 2017). The human component of IS use in the HOT-Fit model includes system use and user attributes, such as actual use, frequency of use, knowledge, training, and attitude towards using the system, all of which impact IS utilization (Yusof, Kuljis, et al., 2008; Muslimin, Hadi & Nugroho, 2017). The technology characteristics, comprising of system quality, service quality, and information quality, determine the value derived from using the IS.

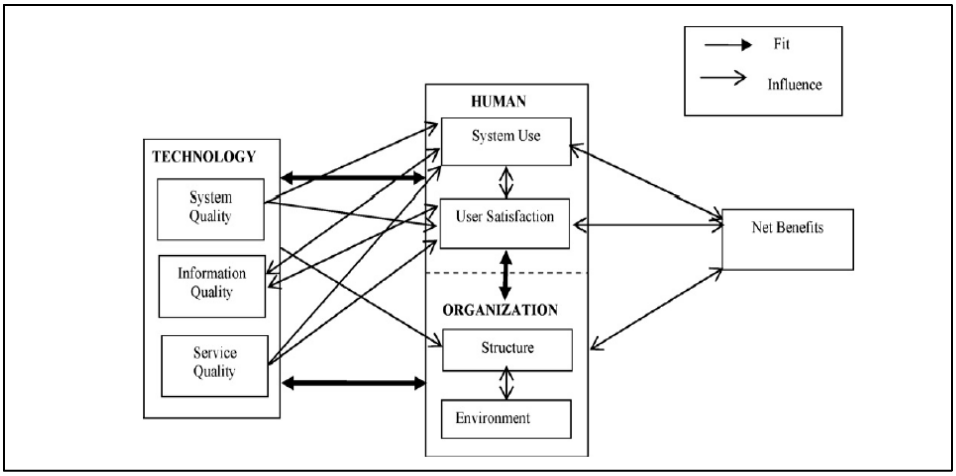



**Figure 3-5: HOT-Fit Framework (Yusof et al., 2008)**

A limitation of HOT-Fit is that variables in the human dimension do not explain the factors that influence user acceptance of IS (Hariyanti et al., 2018).

The HOT-Fit framework maps human factors to system use and user satisfaction (Kilsdonk, 2016), making it relevant to evaluating the UX of an eModeration system. User satisfaction has been positively related to system use and the benefits derived from it. The better the technology quality, the more satisfaction with its use (TryWindy et al., 2020). Thus, if moderators perceive the eModeration system to be useful, then the likelihood of satisfaction increases.

Aspects of Hot-Fit relevant to the evaluation of an eModeration system include ease of use as it relates to the fit factor between human, organization, and technology, flexibility, and the fit between the human, organization, and technology. Mohamadali and Garibaldi (2012, p. 121) argue that evaluating “ease of use” alone is not sufficient to understand user acceptance. If the ease of use is evaluated on its own, the question of why a particular system is accepted in one setting and rejected in another setting cannot be answered. Ease of use is therefore dependent on the “fit” factor between the user, organization, and technology (Mohamadali & Garibaldi, 2012, p.121; Bain et al., 2020). Users who accept/adopt the system may have the requisite skills and knowledge to use the system, indicating a good fit between the user and technology. Conversely, users who reject the system may not have the necessary skills and knowledge, indicating an absence of fit (Mohamadali & Garibaldi, 2012). The Hot-Fit framework, which incorporates a fit between human, organization, and technology is therefore relevant in evaluating the ease of use of an eModeration system (Bain et al., 2020).

HOT-Fit incorporates flexibility as part of system quality, which refers to how easily a system’s design can be adapted to external circumstances (Kilsdonk, 2016). The HOT-Fit framework is adaptable to different contexts, evaluation methods, and stakeholder perspectives (Mirabolghasemi et al., 2019). Thus, the HOT-Fit framework is useful in evaluating the ease of use and flexibility of an eModeration system. It can help understand stakeholders’ engagement and cater to the varying needs of moderators and teachers in the eModeration context (Singh & Mansotra, 2019).

The success of an eModeration system depends on multiple factors, including the fit between the system, users, and the organizational context of use. The HOT-Fit framework, which considers the interplay between human, technology, and organizational factors, is relevant in the evaluation of an eModeration system. The ease of use and flexibility of the system, as well as the fit between user attributes, system quality, and organizational context, are important considerations in ensuring that the system meets the specific needs of moderators and teachers (Yusof et al., 2008; Bain et al., 2020). The adaptation of the system to the unique needs of the stakeholders will increase the chances of user satisfaction and effective use of the system.

#### 3.4.6. Summary of applicability of technology acceptance models to identified eModeration usability constructs

Considering the preceding discussion, the applicability of each of the Technology Acceptance Models, based on the identified usability constructs, is summarized in **Table 3-1**. A tick (✔) indicates that the model applies to the identified eModeration usability construct, a cross (**x**) indicates that the model is not applicable, and no value indicates that no evidence was found of the applicability of the criterion to the model in question.

**Table 3-1: Summary of applicability to identified eModeration usability constructs**

| MODEL | Ease of use | Effectiveness | Efficiency | Learnability | Satisfaction | Context of use and flexibility | Alignment between human, task, and technology |
|---|---|---|---|---|---|---|---|
| **TAM/UTAUT** | ✔ | x | | x | x | x | x |
| **TOE** | x | x | | | | ✔ | x |
| **TTF** | ✔ | x | ✔ | ✔ | ✔ | x | ✔ |
| **HOT-Fit** | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ | ✔ |

Technology acceptance models justify why certain IS are more readily accepted than others. While acceptance is a pre-condition for success, acceptance is not analogous to success (Petter et al., 2008). Evaluation of an eModeration system must consider the constructs for IS success to determine if the system is meeting its intended goals.

## 3.5. Information system success

The Delone and McLean (D&M) IS Success Model (see **Figure 3-6**) is an extensively used, empirically validated model that identifies and quantifies elements of IS success (Delone & McLean, 1992; Petter et al., 2013). The model was constructed around communication theory and adapted to IS (Petter & McLean, 2009). Six interdependent elements of IS success, namely, system quality, information quality, use, user satisfaction, individual impact, and organizational impact are defined (Petter et al., 2013).

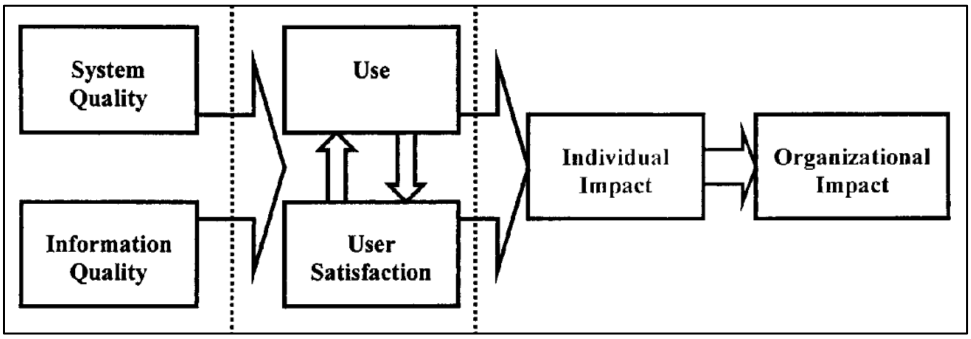



**Figure 3-6: Original D&M Model (DeLone & McLean, 2003)**

"Systems quality measures technical success; information quality measures semantic success; and use, user satisfaction, individual impacts, and organizational impacts measure effectiveness success" (DeLone & McLean, 2003, p. 10). A revised model, the Model of User Satisfaction (see **Table 3-2**), includes variances in user perceptions of user satisfaction and usefulness. Additionally, System Importance and Usefulness were added to the D&M Success Model and Organizational Impact and Individual Impact were removed (Seddon & Kiew, 1996). Reviewing criticisms of their work, DeLone and McLean (2003) revised their model to produce an updated D&M model to improve its accuracy and relevance (DeLone & McLean, 2003). System Importance and Usefulness were added to the D&M Success Model and Individual impact and organizational impact were incorporated into net benefits (Petter & McLean, 2009). New constructs (System Importance and Usefulness) were added (see **Table 3-2)**.

**Table 3-2: IS success models**

| MODEL | CORE PRINCIPLES | CONSTRUCTS | REFERENCE |
|---|---|---|---|
| DeLone and McLean (D&M) IS Success Model. | Multidimensional model to understand and measure IS success. | Individual Impact<br>Information Quality<br>Organizational Impact<br>System Quality<br>Use<br>User Satisfaction. | Petter et al. (2008, 2013). |
| Model of User Satisfaction. | Based on the D&M IS Model, Usefulness replaced Use, and System Importance was included to justify discrepancies in users' experiences of Usefulness and User Satisfaction. | Information Quality<br>System Importance<br>System Quality<br>Satisfaction<br>Usefulness. | Seddon and Kiew (1996). |
| Updated D&M model. | Net benefits replaced individual and organizational impact, allowing the model to pertain to the most relevant level of analysis (Petter et al., 2008). | Information Quality<br>Net benefits<br>Service Quality<br>System Quality<br>System Use<br>User Satisfaction. | Yusof et al. (2008); Petter et al. (2013) |

Researchers have extended and adapted the model to fit various contexts. For instance, Nyagowa, Ocholla, and Mutula (2011) evaluated the success of an eSchool system; Lwoga (2014) investigated the critical success factors for the adoption of a web-based learning management system; Ramirez-Correa, Javier Rondan-Cataluña, Arenas-Gaitán, and Alfaro-Perez (2016) applied the D&M Success Model in the context of a learning management system, and Mukred and Yusof (2018) considered the adoption of an electronic records management system in HEIs.

The D&M Model highlights the importance of considering the relationship between the use of an IS and user satisfaction. Although use procedurally precedes user satisfaction, the positive experience arising from such use initiates greater user satisfaction. Thus, increased "user satisfaction" leads to increased "intention to use" and "use" of the system (DeLone & McLean, 2003, p. 23).

A criticism of the D&M model is that it does not consider factors that may affect peoples' evaluations of success (Seddon & Kiew, 1996). It is unlikely that the user of a system will regard the system as useful (irrespective of how easy it is to use or how well-designed the system is) if the function performed by the system is unimportant to the user (Seddon & Kiew, 1996; Venkatesh & Davis, 2000). Conversely, a user may view a poorly designed system as useful, even if is not easy to use, if the functionality supported is deemed to be important (Seddon and Kiew; 1996). It is important to consider the user's perceived importance of the system's functionality and their level of satisfaction with the system's performance to accurately evaluate the success of an IS. The interaction between technology and human is crucial in determining the success of an Information System.

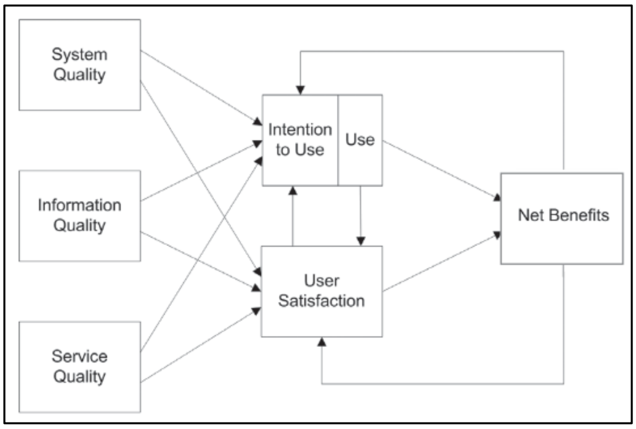



**Figure 3-7: Updated D&M Model (Petter et al., 2013)**

The applicability of D&M Success criteria to eModeration is mapped to the identified eModeration requirements in **Table 3-3.** There is a correlation between IS Success criteria and user-identified requirements for an eModeration system.

**Table 3-3: Mapping of IS Success constructs to eModeration Requirements**

| **Construct** | **System quality** | **Information quality** | **Service quality** | **Use** | **User satisfaction** | **Net benefit** |
|---|---|---|---|---|---|---|
| **Definition** (DeLone & McLean, 2003; Petter & McLean, 2009 | The desired features of the system. | Qualities of the output offered by the IS. | Support of users by the IS department of the organization. | Anticipated future utilization of an IS. | Measures user approval of an IS and its output. | The effect the IS has on an individual or organization. |
| **Mapping to identified eModeration requirements** (Rajamany, 2020) | Ease of Use<br>Availability<br>Reliability<br>Response Time<br>Compatibility<br>Flexibility<br>Complexity | Accuracy<br>Timeliness<br>Completeness<br>Output quality<br>Security<br>Legibility<br>Data currency | Technical Support | Job effects<br>The usefulness of system features and functions | Satisfaction with specific functions<br>Ease of Learning<br>Ease of Use<br>Confidence<br>Task Performance<br>Output Quality | Productivity<br>Job Effects<br>Efficiency |

The identified requirements of an eModeration system correlate to the IS Success constructs. Additionally, from the mapping of the eModeration requirements to the Use construct, use correlates to the usefulness of the system. The D&M model is relevant in evaluating an eModeration system as it considers the interdependence of factors that contribute to the success of an IS.

## 3.6. User experience frameworks

Considering the user experience of an IT system, it is important to examine how previous IT implementation and technology acceptance research has applied learning theories and concepts in the education research field (Korpelainen, 2011). In the following sections, the basic premises of three existing UX frameworks are outlined. The applicability of these UX frameworks to eModeration is tabulated. In each table, the variables applicable to the eModeration context are indicated with a yes or a no, and a justification is provided as to why the specific variable is applicable.

### 3.6.1. Framework 1: User Experience Research Framework

Mahlke (2007) proposes a research framework that conceptualises user experience as comprising instrumental and non-instrumental quality perceptions, together with users' emotional reactions to better understand how people experience technology (see **Figure 3-8**). The system properties, user characteristics, and context or task parameters impact the three central components of instrumental qualities, non-instrumental qualities, and emotional user reactions.

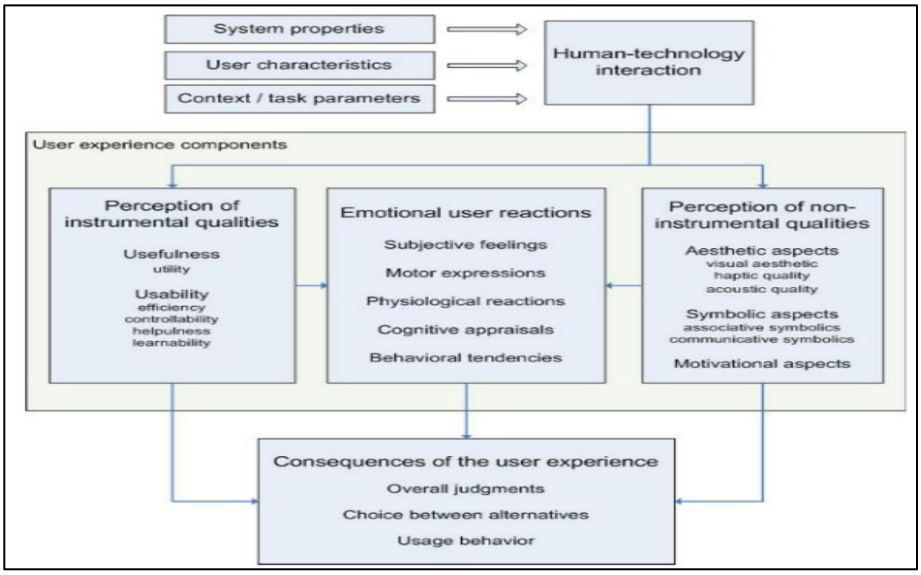



**Figure 3-8: User Experience Research Framework (Mahlke, 2007, p. 27)**

Instrumental qualities refer to the ease of use of a system, which encompasses features such as the effectiveness of its functionality. Non-instrumental qualities address user needs that extend beyond the efficient achievement of tasks to incorporate emotional reactions to the appearance and experience of the system (Mahlke, 2007; Mahlke & Thüring, 2007).

The components of the User Experience Research Framework are tabulated in **Table 3-4**.

## Table 3-4: User Experience Research Framework

| **Framework: User Experience Research Framework** | | | **eModeration System** | |
|---|---|---|---|---|
| **Reference:** Thüring and Mahlke (2007, p. 27); Mahlke (2007) | | | **Applicability** | **Justification** |
| **Domain:** Portable digital audio players | | | | |
| **Components** | **Constructs** | **Variables** | | |
| Instrumental qualities | Usefulness | Utility | yes | Exclusionary and inclusionary criteria for these constructs are based on the underlying theoretical foundation informed by literature, as discussed in **Section** 3.5.2. |
| | | Efficiency | yes | |
| | Usability | Controllability | no | |
| | | Effectiveness | yes | |
| | | Helpfulness | yes | |
| | | Learnability | yes | |
| Non-instrumental qualities | Aesthetic aspects | Visual aesthetics | yes | The evaluation of an eModeration system is based on the functional usability of the system and on overall satisfaction with the functionality. The visual aesthetics will contribute to the overall satisfaction that the user feels while using the system. The focus of this study is on usability; hence, the other variables are not applicable. |
| | | Haptic quality | no | |
| | | Acoustic quality | no | |
| | Symbolic aspects | Associative symbolics | no | Not applicable to the eModeration context as teachers and moderators will communicate digitally. |
| | | Communicative symbolics | no | |
| | Motivational aspects | No variables are identified. | Yes | |
| Emotional user reactions | | Subjective feelings | yes | A positive experience can create a sense of satisfaction, while a negative experience can lead to feelings of mistrust or dissatisfaction. |
| | | Motor expressions | no | Although emotions are important, it is not necessary to measure motor expressions or physiological reactions as the eModeration context does not elicit extreme emotions. |
| | | Physiological reactions | no | |
| | | Cognitive appraisals | no | |
| | | Behavioural tendencies | no | |

### 3.6.2. Framework 2: M-health User Experience Framework

Ouma (2013) describes a user experience framework for a mobile health application specific to the healthcare sector in South Africa (see **Figure 3-9**).

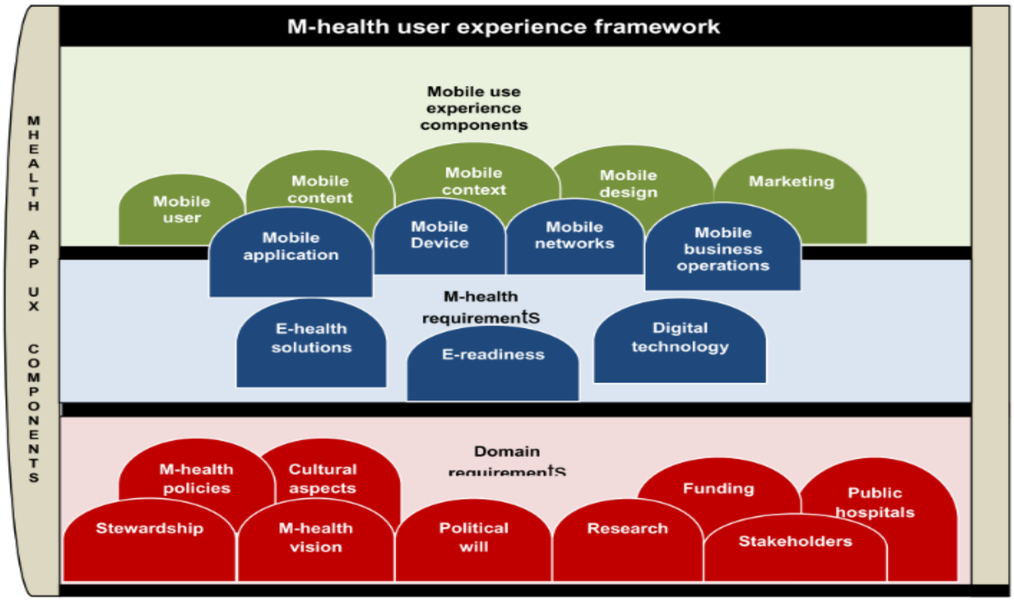



**Figure 3-9: M-health user experience framework (Ouma, 2013, p.271)**

The three main components of the M- health User Experience Framework comprises three domains:

- Mobile user experience components are comprised of user characteristics, user expectations, emotions, motivation, experience, user roles, and goals.
- M-health technology requirements impact the use of m-health applications. The users' engagement with the application are influenced by aspects such as the user's pragmatic goals, the available software and hardware, the infrastructure, and usability and interoperability considerations.
- Domain requirements are essential to improve the user experience. These requirements include supporting the vision and mission of the health department, stakeholders implementing the application, m-health policies, and meeting the needs of various services provided by different levels of hospitals.

The components of the M-health user experience framework are tabulated in **Table 3-5**.

**Table 3-5: Applicability of M-health components to an eModeration system**

| **Framework: M-health User Experience Framework** | | | **eModeration system** | |
|---|---|---|---|---|
| Reference: Ouma (2013) | | | | |
| Domain: Public health System | | | **Applicability** | **Justification** |
| Mobile User Experience Components | Mobile User | User characteristics | yes | Although the context is the mobile environment, user characteristics and goals apply to the eModeration domain and may affect the user experience of the system. |
| | | User goals | yes | |
| | | Resources available | yes | Mental resources determine the time taken to learn how to use the system. |
| | | User expectations | yes | Determine user satisfaction. |
| | | Diversity of users | yes | Tasks that moderators perform are different to those that teachers need to perform. |
| | | Users' emotions | yes | A positive experience can create a sense of satisfaction, while a negative experience can lead to feelings of mistrust or dissatisfaction. |
| | | Users' motivation | yes | The usefulness of the eModeration system will determine how motivated the user is to use the system. |
| | | User experience | yes | User experience and prior knowledge will impact their interaction with an eModeration system. |
| | | Knowledge | yes | |
| | Mobile context | Spatial context | no | Teachers' jobs do not require them to be on the move. Mobility is therefore not a consideration. |
| | | Mental context | no | |
| | | Task context | no | |
| | | Infrastructural context | no | |
| | | Social context | no | |
| | Content | Informative | no | An eModeration system does not provide content, but enables the production of content in the form of a moderator report. It is not an inherent function of the system nor a requirement for moderation. |
| | | Useful | yes | The onscreen information that is provided should allow the user to easily navigate the eModeration environment. |
| | Design | Visual presentation | yes | A consistent interface is necessary for users to learn to use the system easily. |
| | | Layout | no | The eModeration context is not inherently a mobile application domain that has specific requirements to ensure readability due to the smaller screen size of a portable device. |
| | | Visual flow | no | |
| | Marketing | Awareness | no | There will not be a need to market the product in the domain of application. |
| M-health | Application | Type of m-health application | no | |

| Framework: M-health User Experience Framework | | | eModeration system | |
|---|---|---|---|---|
| Reference: Ouma (2013) | | | | |
| Domain: Public health System | | | Applicability | Justification |
| | | Design guidelines for applications | no | Specific to the mobile technology environment; therefore not applicable to an eModeration system. |
| | Mobile Device | Hardware | no | |
| | | Software issues | no | |
| | M-health infrastructure | E-health infrastructure | no | Specific to the mobile environment, which does not apply to the eModeration context. |
| | | Cellular networks | no | |
| | | Wireless networks | no | |
| | | Mobile business operations | no | |
| | Digital technology | Interoperability | no | |
| | | Privacy issues | yes | The eModeration system should maintain the security and privacy of users. |
| | | Interoperability issues | yes | eModeration systems should promote the sharing of information. |
| | | Usability issues | yes | An eModeration application should be easy to learn, easy to use, and free from errors. |
| Domain Requirements | | M-health vision and mission | no | Domain-specific requirements for the mobile health system do not apply to the eModeration environment. |
| | | M-health stakeholders | no | |
| | | M-health policies | no | |
| | | M-health needs | no | |
| | | Funding issues | no | |
| | | Research | no | |
| | | Political will | no | |
| | | Level of hospitals | no | |
| | | Stewardship | no | |
| | | Cultural aspects | no | |

### 3.6.3. Framework 3: User Evaluation Framework for eModeration

The User Evaluation Framework (see **Figure 3-10**) consists of three levels, as explained below:

- Environment level: identifies “users” and “organisation” (Van Staden, 2017, p. 354) as constructs, with users having defined roles and responsibilities;
- eModeration requirements level: specifies the processes involved in moderation. This level ensures that secure access is provided and that processes are in place to upload documents for moderation, track the moderation process, download moderation reports, and provide feedback to assessors; and

- ➢ eModeration user experience construct level: identifies instrumental and non-instrumental qualities that work together with the Environment and eModeration requirements levels to affect the user experience.

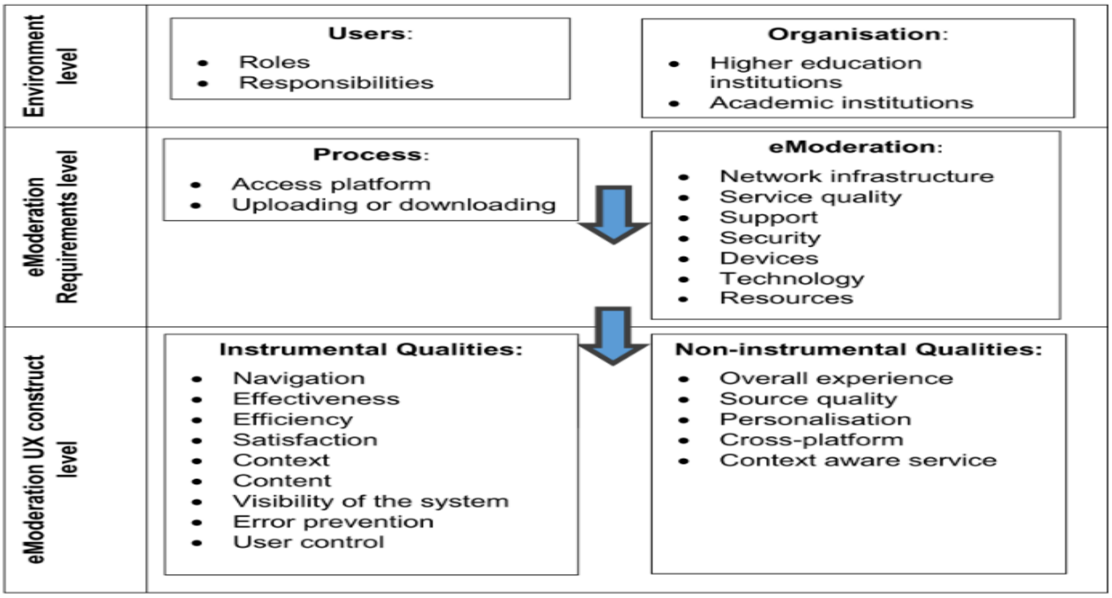



**Figure 3-10: User experience evaluation framework for eModeration (Van Staden, 2017, p.357)**

The components of the User Evaluation Framework for eModeration are depicted in **Table 3-6**.

**Table 3-6: Applicability of User Evaluation Framework to the eModeration system**

| **Framework: User Evaluation Framework** | | | **eModeration system** | |
|---|---|---|---|---|
| Reference: Van Staden (2017) | | | Applicability | Justification |
| Domain: Academic institutions | | | | |
| Constructs | | | | |
| Environment level | Users | Roles | yes | The roles and responsibilities of teachers and moderators differ in an eModeration system, and the process followed is dependent on which role the user adopts. |
| | | Responsibilities | yes | |
| | Organization | Higher education institutions | no | The environmental context of this study is the secondary school environment, that is, an academic institution. |
| | | Academic institutions | yes | |
| eModeratio | Process | Access platform | yes | |

| Framework: User Evaluation Framework | | | eModeration system | |
|---|---|---|---|---|
| Reference: Van Staden (2017) | | | Applicability | Justification |
| Domain: Academic institutions | | | | |
| Constructs | | | | |
| | | Uploading or downloading | yes | The eModeration system would provide the platform to upload and download documents for moderation. |
| | eModeration | Network infrastructure | yes | Moderators and teachers should have access to the necessary service, support, and technology resources. |
| | | Service quality | yes | |
| | | Support | yes | |
| | | Security | yes | |
| | | Devices | yes | |
| | | Technology | yes | |
| | | Resources | yes | |
| eModeration UX construct level | Instrumental qualities | Navigation | yes | Moderators and teachers must be able to easily navigate the system, which allows them to effectively complete their respective tasks in the least possible time with satisfaction. |
| | | Effectiveness | yes | |
| | | Feedback | yes | |
| | | Efficiency | yes | |
| | | Satisfaction | yes | |
| | | Context | yes | Identified in the task requirements. |
| | | Content | yes | Being able to easily access appropriate content is important for efficiency and effectiveness. |
| | | Visibility of the system | yes | Ensures that the navigation links are unambiguous. |
| | | Error prevention | yes | Users need to be able to easily recover from any errors that occur whilst using the system. |
| | | User control | yes | The eModeration system provides the user control over the processes that need to be carried out. |
| | Non-instrumental qualities | Overall experience | yes | Ensures that the overall experience of the user is positive. |
| | | Source quality | no | Incorporated into information quality. |
| | | Personalisation | yes | Interface can be personalized to suit different roles and preferences. |
| | | Cross-platform | yes | Moderators and teachers should be able to access the system via different devices and platforms. |
| | | Context-aware service | no | Identified in the task requirements. |

### 3.6.4. Applicability of existing UX frameworks to eModeration

The constructs of Mahlke and Thüring's (2007) User Experience Research Framework applies to an eModeration system, which also consists of the interaction between the user, the task, and the system. The user experience is an outcome of the interaction between the instrumental and non-instrumental quality perceptions of the user and the emotional user reactions arising from this interaction (Mahlke, 2007). As with an m-health application, the user and technology are important user experience components of an eModeration system.

The eModeration user experience framework proposed by Van Staden (2017) is most applicable to this study as the context of use is similar. The difference is that the evaluation framework developed in this study was tested in the private secondary school environment rather than the HEI environment.

While the three frameworks discussed are based on systems that have already been deployed, this thesis used a prototype specifically created for the domain in which the evaluation framework will be used.

### 3.6.5. User experience constructs

The perception of a product is based on the individual values of the user and the context of use, therefore the perception of user experience is highly subjective (Jetter & Gerken, 2007). Adopting Hassenzahl et al.'s (2010) description of UX as a dynamic, context-dependent, and subjective account of human–technology interaction, the influence of the context, user, and the system on UX is depicted in **Figure 3-11.**

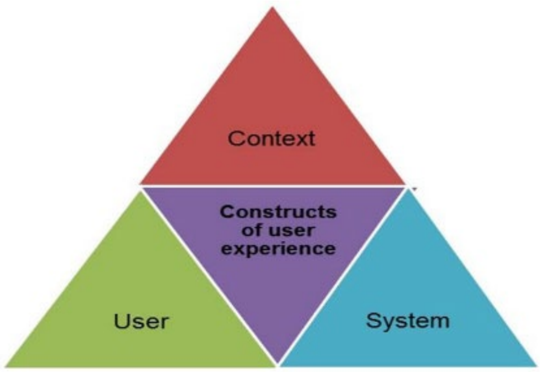



**Figure 3-11: Influence of context, user, and system on user experience (Van Staden, 2017, p. 196)**

### 3.6.6. Definition of UX for this study

In this study, UX refers to the user experience related to the usage of a system as recommended by Law et al. (2009). Hassenzahl and Tractinsky (2006) categorize UX components as a consequence of the user's internal state, the characteristics of the system, and the context within which the interaction occurs. Roto (2006), Roto and Kaasinen (2008) and Tan et al. (2013) identify attributes related to each component, as depicted in **Table 3-7**.

**Table 3-7: UX attributes**

| UX Component | System | Context | User |
|---|---|---|---|
| Attributes | Product | Physical context | User needs |
| | Object | Social context | Mental resources |
| | Service | Temporal context | Physical resources |
| | Infrastructure | Task context | Emotional state |
| | Complexity | | Experience |
| | Purpose | | Expectations |
| | Usability | | |
| | Functionality | | |

In line with Hassenzahl's (2007) view that pragmatics is much more influenced by tasks than hedonics, is and Tan et al's. (2013) explanation of context as inclusive of the physical, social, temporal, and task contexts; the context is described in terms of the task requirements (see **Table 3-9)** which, together with the user characteristics, impacts on the user. The task is therefore a fundamental aspect of user-centred analysis and evaluation techniques (Hassenzahl & Tractinsky, 2006). The interaction between the user, the eModeration system, and the context is depicted in **Figure 3-12**.

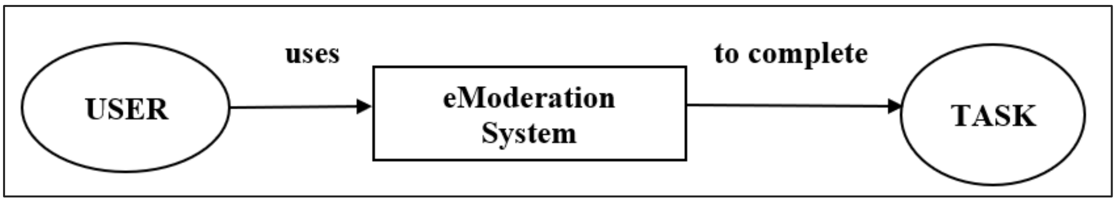



**Figure 3-12: Interaction between the user, the system, and the task in an eModeration system**

Desmet and Hekkert (2007) maintain that user experience is shaped by user characteristics (e.g., personality, skills, etc.) as well as those of the system (e.g., aesthetics). Users' perceptual and cognitive processes, for example, remembering and understanding, contribute to this experience, while the context in which the interaction takes place influences the experience. It is therefore important to consider system properties, user characteristics, and the usage situation when designing and evaluating interactive systems (Mahlke, 2007). The context is described as a UX component that includes systems and objects that are not part of the system, but that affect the UX of the system (Roto, 2006). Roto (2006) further outlines the following aspects of the context:

- The physical context refers to the tangible physical surroundings that affect the user, for instance the outside temperature.
- The social context refers to the expectations from, and influences of other people and/or the readiness of, the user to share in social situations.
- The temporal context refers to the time dedicated to the use of the system given context restrictions.
- The task context refers to the role of the system in fulfilling the higher-level goals of users.

An eModeration system is a tool to deliver a good UX. Conceptualising the system as an agent (Adie, 2011) in the process of online moderation expands the inquiry to include an investigation of how the technology interacts and affects the moderation process (task). The user surroundings, social influences, and time dedicated to system use are not relevant to the eModeration context, nor are these contexts included in the inherent functionality of the system. Thus, based on Roto's (2006) definitions, the physical, social, and temporal contexts do not apply to an eModeration system. In line with Roto's (2006) suggestion that it is beneficial to carefully consider the task context in a specific use case scenario, the context has been replaced by task in this study (see **Figure 3-13**).

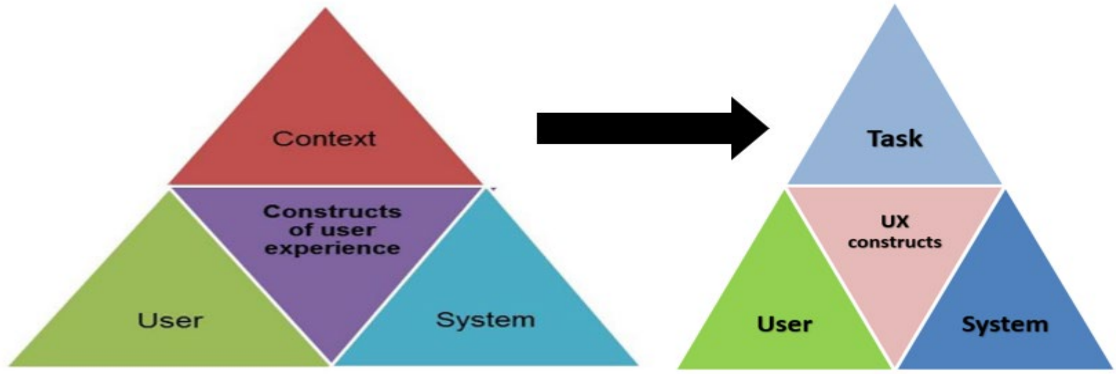



**Figure 3-13: UX Requirements (adapted from Van Staden, 2017, p. 196)**

Against the background of definitions (see **Table 2-6**) and frameworks (**Section** 3.7) associated with user experience discussed in the preceding sections, the following high-level components are included in a theoretical framework for eModeration in this study:

- eModeration system components (system);
- eModeration user components (user); and
- eModeration task components (task).

## 3.7. Theoretical Framework

Drawing on the analysis of Technology Acceptance Models, IS success models, and the discussion on usability and UX within the field of HCI, **Section 3.7.1** tabulates the applicability of the preceding theories to eModeration. **Section 3.7.2** isolates the specific constructs to be included in a theoretical framework (see **Table 3-8**).

### 3.7.1. Applicability of theories to eModeration

The theories behind HCI, Technology Acceptance Models, and IS Success Models are tabulated (see **Table 3-8**) based on the following attributes of analysis: basic premise, core attributes, limitations, and constructs applicable to eModeration.

**Table 3-8: Theories informing theoretical framework**

| THEORIES | ATTRIBUTES OF ANALYSIS | | | |
|---|---|---|---|---|
| | **Basic premise** | **Core attributes** | **Limitations** | **Constructs applicable to an eModeration system** |
| HCI | Provides users with context-specific experiences to make systems more usable and useful. Usability is an essential aspect referring to the quality of the user interface.<br>User–Product interaction is a significant research area. | Usability<br>User experience<br>Quality in use – attributes associated with users' interaction with a system<br>Product quality: specifies product attributes. | Different definitions of usability. | Quality in use (usability)<br>Product quality<br>Context of use<br>User experience. |
| TAM | Predicts user adoption/acceptance decisions.<br>Matches task and technology attributes. | Measures attitudes towards the use of technology.<br>Suitable for pre-adoption of technology.<br>The focus is on behavioural intention to use. | Only considers user perceptions, not the actual technology.<br>Excludes social, psychological, and organizational factors.<br>Excludes task characteristics.<br>Ignores positive emotions.<br>Focuses on user attitudes rather than performance measures. | Perceived ease of use.<br>Perceived usability.<br>User perceptions (UX)<br>(Venkatesh and Bala, 2008). |
| HOT-Fit | The functionality, content, and usability of a system determine its success. | The fit between human, organization, and technology is central to the effective application of IS. | Variables in the human dimension do not explain factors that influence user acceptance. | Usability<br>System functionality<br>(Yusof et al., 2008. |
| IS success | Evaluation framework to identify and quantify elements of IS success.<br>The functionality, content, and usability of the system determine its success. | System quality<br>Information quality<br>Service quality<br>Use<br>User satisfaction<br>Net benefit. | Does not consider factors that affect how people evaluate success. | System quality<br>Information quality<br>Service quality<br>User satisfaction<br>(DeLone & McLean, 2003). |

The constructs applicable to an eModeration system, as outlined in **Table 3-8**, are discussed further in the following section and a justification is provided for their inclusion or exclusion in the theoretical framework underpinning this study.

### 3.7.2. IS constructs included in the theoretical framework

Considering IS Success Models, three measures pertinent to the quality of information systems are system quality, information quality, and service quality, which are explained as follows:

- System quality measures the technical success of an IS and refers to the user's perception of the system's overall performance, including system performance, the system's precision and efficacy in producing information, and the user interface (Yusof et al., 2008; Yu & Qian, 2018; TryWindy et al., 2020). The interaction with an information system is a personalized experience for each user. This interaction produces different results depending on how the user views the interface (Muhammad & Muhammad, 2010). Examples of system quality measures are ease of use, ease of learning, response time, usefulness, availability, reliability, completeness, system flexibility, and security (Yusof, 2008).

- Information quality: refers to the "degree to which the software provides accurate, suitable, accessible and legally compliant information" (Lew et al., 2010, p. 223; Yu & Qian, 2018). Information quality epitomises the semantic success of the system, including measures of the value of the information that the system generates and its utility for the user. As such, information quality is regarded as a significant antecedent for user satisfaction (Mohammadi, 2015), thus contributing to the user's interaction with the system (see **Figure 3-12**) and the functional characteristics of the IS.

- Service quality refers to the quality of the support that users receive from IT support (Petter et al., 2013; TryWindy et al., 2020). Service quality affects the use of and user satisfaction with the eModeration system (Pitt et al., 1995). Users who have greater self-confidence in their abilities to use a system are more likely to use the system (Petter et al., 2013). As user self-efficacy is deemed to be an important predictor of IS success, Petter et al. (2013) recommend that organizations should provide proper support for IS.

A review of IS success models illustrates that the main constructs identified by the D&M model are still being empirically tested and used by IS researchers in diverse contexts (Ramirez-Correa et al., 2016).

System quality, information quality, and service quality have a direct impact on the usability of a system (see Figure 3-7). Lew et al. (2010) suggest that information quality, which can be evaluated as an internal or external quality characteristic, should be added as a quality in use characteristic. When designing tasks for quality in use, content and functions are embedded in the task design itself rather than as attributes of the software. Accordingly, in this study, information quality was included as an aspect of system requirements (external quality characteristic) and as part of the task design (internal quality characteristic), which will affect the quality in use (**Figure 3-14)**.

**Section 3.8**. presents the selection of constructs for the evaluation of an eModeration system based on the outlined definitions of usability and the importance of the interaction between the user, the system, and the task.

## 3.8. Usability constructs pertinent to an eModeration system

The focus of this study on an eModeration system is on how well the system meets users' needs and the ability of the system to efficiently help the user to solve a given task (Hedegaard & Simonsen, 2013; Rose et al., 2017).

In line with the views expressed by Nielsen (1993) and Lew et al (2010), namely, that researchers need not pay equal attention to all usability attributes and that some attributes may be more applicable to some domains than others, the constructs common to various definitions of usability (see **Table 2-4**) are isolated to define usability specifically in the eModeration context. Although many constructs could be influential, not all of these constructs apply to a teacher's use of an eModeration system.

The effectiveness, efficiency, and satisfaction with which users accomplish their objectives will determine the usability of the system. In turn, the quality of the interaction between the stakeholder (moderators and teachers), the system, and the task determines the efficiency, effectiveness, and satisfaction measures derived from the system. The ISO standards provide precise definitions of usability constructs and clear demarcations of the differences between them. In addition to the standard constructs of Effectiveness, Efficiency, and Satisfaction, Learnability is common to all explanations of usability constructs (see **Table 2-4**). The construct Errors is common to four of the definitions of usability (see **Table 2-4**); however, using Nielsen's (1993, 1996) description of usability as a measure of how well users can use the system's functionality (see **Table 2-4**), Errors is not selected as a construct for further discussion. Reliability incorporates errors and is included as part of system quality (see **Table 3-8)**. Although Flexibility is common to only two of the definitions of Usability in **Table 2-4**, empirical evidence indicates Flexibility as part of system quality in IS Success models (Petter et al., 2013). Additionally, data from the participatory design workshops indicate the importance of including Flexibility as a construct for an eModeration system.

The usability of an eModeration system can be specified and tested using a collection of core functional constructs reviewed in the literature. These constructs are discussed with reference to how effectively the user's goals are met (effectiveness); how efficient the eModeration system is in allowing expert users to attain a high level of productivity (efficiency); how easy it is to learn to use the eModeration system (learnability); how pleasant it is to use or subjectively satisfy users of the eModeration system (satisfaction); and how the eModeration system can be adapted for different users, devices, and tasks (flexibility) (Bevan, 2001; Green & Pearson, 2006; ISO-IEC, 2018; ISO-IEC 25010, 2011; Lee, 1999; Nielsen, 1993, 1996).

Effectiveness can be explained in terms of whether the system does what it is intended to do (Atoum et al., 2014), and is described as the "the extent to which the system adds to the achievement of organizational goals and benefits" (Santa, MacDonald and Ferrer; 2019, p. 41). Within the context of this study, effectiveness refers to the degree to which users achieve specified goals as measured against the criteria of correctness and completeness (Ferreira et al., 2020). Effectiveness is a critical component in determining the usability of an IS (ISO-IEC, 2018; ISO-IEC 25010, 2011), focussing on completing activities and the quality of the task outcome (ISO-IEC, 2018; Santa et al., 2019).

Efficiency is explained as the resources expended in relation to the accuracy and completeness with which users achieve their goals (ISO-IEC 25010, 2011), and refers to the comparison of what is actually performed with what can be achieved with the same consumption of resources (Atoum et al., 2014). Efficiency is a measure of how productive a system is without any waste of time, financial, and/or human resources (Centobelli et al., 2019). The focus is on performing tasks optimally and satisfying the needs of various types of users (Cioloca et al., 2013; Rai &

Selnes, 2019; Santa et al., 2019). Due to its significant impact, user efficiency is often regarded as the most important attribute of usability (Nielsen, 1993).

Satisfaction is defined as the “degree to which user needs are satisfied by using a product or system in a specified context of use” (Ferreira et al., 2020, p. 1; ISO-IEC 25010, 2011). The updated version of the ISO standards defines satisfaction as the “extent to which the user's physical, cognitive and emotional responses that result from the use of a system, product or service meet the user’s needs and expectations” (ISO-IEC, 2018). In contrast to the former definition, which emphasizes the context of use as important in determining the satisfaction that the user derives from using the product, the latter definition highlights the user experience that arises from the ability of the system to meet the user’s needs. Satisfaction is an important measure in evaluating the effectiveness of an eModeration system as users’ cognitive processes, together with emotional and affective elements, influence the intention to use technology (Taherdoost, 2018; Rai & Selnes, 2019).

Learnability refers to the degree of ease with which a user can interact with a new system. As a usability attribute, a system is regarded as easy to learn when users can progress quite quickly from not knowing the system to completing a task (Nielsen, 1993, 1996). The extent of use is explained as the user’s capability of becoming proficient with an application (Weichbroth 2020, p. 55569). Learnability in use is defined as the degree to which specified users can learn efficiently and effectively while achieving specified goals in a specified context of use. This characteristic has become part of the quality in use model to account for the learning process and the importance of context of use during learning (Bevan et al., 2016; Lew et al., 2010; Weichbroth, 2020). The ability to quickly and easily use an eModeration system will positively influence the user’s experience of the system (Van Staden, 2017). Accordingly, learnability has been included as a quality in use construct (see **Figure 3-14**) and use was incorporated into learnability.

Flexibility is a quality in use characteristic to evaluate the extent to which a system can be adapted for different types of users, tasks, and contexts to enable users to achieve their goals in contexts “beyond those initially specified in the requirements for the system” (Bevan et al., 2016, p. 275). Flexibility relates to the context of use (Bevan et al., 2016).

Based on the attributes of analysis depicted in **Table 3-8**, the incorporation of constructs related to the IS success models in formulating a theoretical framework for this thesis are discussed in the following paragraphs.

The individual impact of an eModeration system contributes to the overall UX of the individual. The organizational impact is linked with effectiveness and efficiency within the larger context of quality in use. Benefits such as time and cost savings will result from the effectiveness and efficiency with which teachers and moderators complete their tasks (Law et al., 2008; Van Staden, 2017). Thus, net benefit was incorporated into effectiveness and efficiency in the theoretical framework.

Many IT systems are socially constructed and their implementation typically entails considerable learning for them to be implemented and adopted by users (Korpelainen, 2011). Considering learnability solely as a quality of the system does not include differing use contexts, nor does it incorporate an evaluation of the learning process. Minimizing the amount of time required to learn to use a system depends entirely on who the user is and on the tasks that the user is attempting to complete (Lew et al., 2010). Tools with more functionalities will possibly be harder to use. As users acquire more experience with a system, it becomes easier to use (Ajibade, 2018). Similarly, learnability becomes less important when individuals develop behavioural intentions to use the system once they are accustomed to do so (Venkatesh & Bala, 2008). Training improves perceived usability, thus resulting in performance impacts (Farhan et al., 2019). It is necessary to recognize the role of training in the adoption of IT systems, as insufficient learning can limit the adoption and use of a potentially valuable system (Lew et al., 2010). The user and task requirements and their effect on learnability are therefore important in evaluating the UX of an eModeration system.

Given that usability is related to satisfying the do goals of the end user (Lew et al., 2010), satisfaction is positioned as part of the usability constructs contributing to the overall UX (see **Figure 3-14)**. Users' emotions, physical and psychological responses, internal and physical state resulting from previous experiences, and user skills are included as part of the ISO definition (see **Table 2-6**) of UX (Díaz-Oreiro et al., 2019).

The pragmatist perspective advocates a detailed analysis of UX to offer rich insights into interactions between the user and the system (Law et al., 2007), which aligns with the pragmatic approach underpinning this study. Additionally, in line with Lund's (2001) observation that, while subjective reactions to the usability of a system are most closely bound to user behaviour and purchase decisions, there is a tendency to neglect these aspects of user experience in favour of performance measures; hedonic qualities have been included in the theoretical framework.

### 3.8.1. Theoretical framework for the evaluation of an eModeration system

The traditional usability framework focuses primarily on user cognition and user performance in human-technology interactions (Law et al., 2009). In contrast, UX emphasizes the non-utilitarian aspects of such exchanges. The focus is thus shifted to user affect, sensation, and meaning, together with the value of such interaction in everyday contexts (Law et al., 2009). Law et al. (2014) argue that theoretical frameworks should examine the relationship between affect, action, and cognition. Hedonic qualities such as aesthetics and digital literacy have therefore been included in the theoretical framework. The physical technology and task environment are contextual factors that affect the user experience (Law et al., 2009). When designing tasks for quality in use (e.g., for evaluating efficiency and effectiveness in use), content and functions are embedded in the task design itself rather than as attributes of the software, as user experience is related to the usage of a system (Lew et al., 2010).

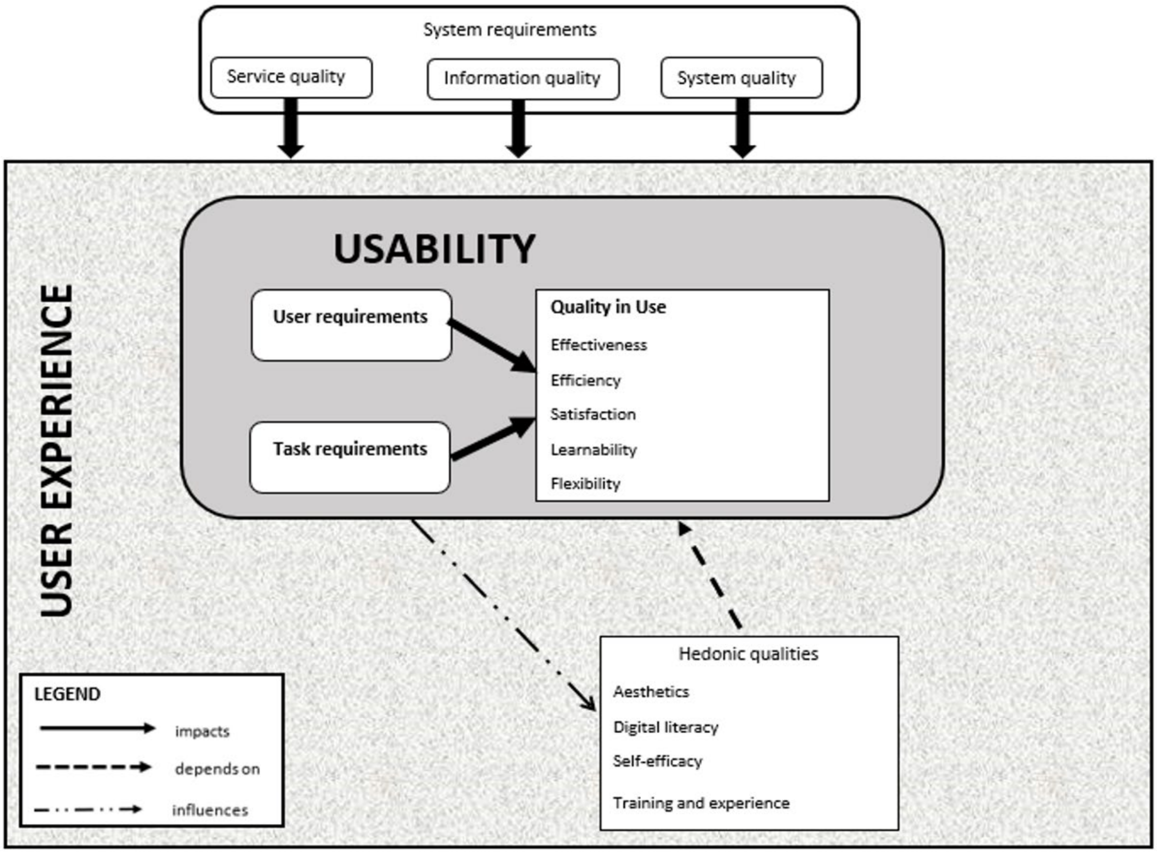



**Figure 3-14: Theoretical framework for eModeration**

As depicted in **Figure 3-14**, and explained in **Section 2.5.3.6**, usability is subsumed by UX. The following section describes the refinement of the UX requirements outlined in Chapter Two.

### 3.8.2. Revised UX requirements for an eModeration system based on theoretical framework

The broad constructs pertinent to the evaluation of the UX of an eModeration system, as identified in the theoretical framework, provides a basis for refining the UX requirements previously identified from the literature into criteria for an eModeration system.

The user, task, and system components (see **Table 2-9**) extrapolated from literature and the requirements (see **Table 2-2)** to evaluate a potential system were refined and categorized into specific usability and UX criteria, as depicted in **Table 3-9.**

**Table 3-9: Refined criteria for evaluating the UX of an eModeration System**

| COMPONENT | CONSTRUCT | CRITERIA | |
|---|---|---|---|
| System | System quality | Audit trail | Multi-user technology |
| | | Availability | Notifications |
| | | Compatibility | Organized file structure |
| | | Complexity | Reliability |
| | | Cross platform | Robust hardware |
| | | External communication | Security |
| | | Flexibility | Synchronization |
| | | Infrastructure and resources | Web-based |
| | Information quality | Accuracy | Legibility |
| | | Compatibility | Output quality |
| | | Completeness | Reporting |
| | | Data currency | Security of information |
| | | Format | Timeliness |
| | Service quality | Technical support | |
| Task | Efficiency | Availability | Quick response |
| | | Cost saving | Reduced printing |
| | | Database of comments | Time saving |
| | Effectiveness | Capability | Usefulness |
| | | Dependability | Voice-over button |
| | | Productivity | |
| User | Satisfaction | Satisfaction with specific functions | |
| | Learnability | Ease of use | Training and experience |
| UX | Hedonic qualities | Aesthetics | Self-efficacy |
| | | Digital literacy | |

The identified criteria are used as a basis for the development of an evaluation framework for an eModeration system in Chapter Six.

## 3.9. Conclusion

A literature review into the areas of HCI, Technology Acceptance Models, and IS Success Models provided a theoretical basis for this study. This was necessary because the eModeration focus of this study lies at the intersection of HCI and IS. A detailed analysis of frequently used technology acceptance models was conducted to determine their applicability in eliciting requirements for an eModeration system. The applicability of the HOT-Fit framework, specifically within the eModeration context, was thus established. The human, organization, technology, and environmental context of deployment emerged as a common theme amongst the three streams of literature reviewed in the fields of HCI, Technology Acceptance, and IS Success. The findings from the different streams of literature were synthesized to propose a theoretical framework within which to position this research into evaluating the UX of an eModeration system. The constructs identified in the theoretical framework, and the criteria from the preceding literature review, provided a basis for isolating specific criteria that can be used to evaluate the UX of an eModeration system. Chapter four describes the research methodology.

# Chapter 4: Research Methodology

## 4.1. Introduction

Chapter Three outlined the functional requirements for an eModeration system. The theoretical framework as well as the literature reviewed provided a basis from which a revised list of criteria to evaluate the user experience of an eModeration system was extracted (see **Table 3-9**).

The objective of this chapter is to present a description of the research process. This chapter is positioned within the relevance cycle of the DSR process. **Section 4.2** presents information on research methodologies and a justification for the methodology used in undertaking this research. **Section 4.3** presents the data analysis. **Section 4.4** presents the the steps taken in ensuring that the research quality and rigour were met in this study. **Section 4.5** briefly outlines the ethical clearance procedures. **Section** 4.6 concludes this chapter.

## 4.2. Research Methodology

The research methodology indicates the strategy in conducting the research (Alharahsheh & Pius, 2020). The choice of the most suitable methodology not only enables the researcher to achieve the objectives set out, but also establishes the credibility of the research (Kallet, 2016; Wedawatta et al., 2011). The research paradigm, research design, and research method are integral components of the methodology and provides the general direction of the research, including the procedure for conducting the research (Alharahsheh & Pius, 2020). The research philosophy is presented in **Section 4.2.1**, the research design is described in **Section 4.2.2**, and the research method is explained in **Section 4.2.3**.

### 4.2.1. Philosophical World View

All research is grounded in fundamental philosophical assumptions of what valid research consists of and which research methods are most pertinent in developing knowledge in that particular field of study (Thomas, 2010). Knowing what these assumptions are when conducting any form of research is therefore important.

#### 4.2.1.1. What is a paradigm

A paradigm refers to a philosophical way of thinking about the development of knowledge and the nature of that knowledge (Oates, 2004; Saunders et al., 2009; Morgan, 2014; Kivunja & Kuyini, 2017). The paradigm describes a scholar's philosophical orientation, which has important implications for decisions such as the choice of the methodology used in the research process. Using Curtin's (2012) and Denscombe's (2008) perception of paradigms as the shared beliefs of a community of scholars, Morgan (2014) maintains that paradigms generate new worldviews and social situations that have widespread effects on the conduct of inquiry.

The paradigm guides the research methods used, impacting on what should be considered, how they should be studied, and how the outcomes of the study should be understood (Kivunja & Kuyini, 2017). The researcher's understandings influence the meaning constructed from the data gathered (Feilzer, 2010; Kivunja & Kuyini, 2017). When conducting any form of inquiry, researchers must ponder the questions of "what it is for", "who it is for", and "how do researcher's values" influence the research (Feilzer, 2010, p. 8). Essentially, a paradigm directs the research effort. **Section 4.2.1.2**. presents four commonly used research paradigms.

#### 4.2.1.2. Comparison of paradigms

Saunders et al. (2009) discuss four paradigms in management research in terms of their ontology, epistemology, axiology, and the data collection methods most often used (see **Table 4-1**).

**Table 4-1: Comparison of four research paradigms (Saunders et al., 2009, p. 119)**

| | **Positivism** | **Realism** | **Interpretivism** | **Pragmatism** |
|---|---|---|---|---|
| **Ontology,** i.e., the researcher's viewpoint on the nature of reality. | The researcher's view is objective, and independent of social actors. | Reality is objective, existing independently of human opinions. | Reality, which may alter, is socially constructed. Multiple, subjective realities may exist. | External view chosen to best answer the research question. |
| **Epistemology,** i.e., the researcher's opinion of what represents | Visible phenomena only can offer reliable data. Focus: causality | Visible phenomena provide convincing facts. Focusses on explaining knowledge within context. | Characterized by subjective connotations and social phenomena. | Observable phenomena and/or personal meanings may deliver satisfactory |

| | Positivism | Realism | Interpretivism | Pragmatism |
|---|---|---|---|---|
| appropriate knowledge. | and law-like generalisations. | | Focusses on details and the reality behind these details. Subjective meanings trigger activities. | information dependent on the research question. Focus: practical research integrating dissimilar perceptions to help understand the data. |
| **Axiology** the researcher's view of the role of values in research. | Research is value-free with the researcher being independent of the data and maintaining an impartial outlook. | Research is value laden. The researcher's understandings, cultural experiences and upbringing create bias that will affect the research. | Research is value-bound. The researcher is a part of that which is being researched and will therefore be prejudiced. | Values inform an understanding of results. The researcher espouses unbiased and biased viewpoints. |
| **Methodology** data collection techniques. | Highly structured, quantitative, and qualitative, using large samples. | Methods must be appropriate to the subject matter. Can be quantitative or qualitative. | In-depth investigations, small samples, qualitative. | Mixed method designs: quantitative and qualitative. |

Within this study's context and its focus on the evaluation of the user experience of an eModeration system, the human component is crucial. Positivism and realism were eliminated from further consideration due to their ontological view that the nature of reality is not dependent on human beliefs (see **Table 4-1**). Interpretivism and pragmatism, on the other hand, focus on the way that humans attempt to make sense of the world around them which, Saunders et al. (2019, p. 141) describe as "discovering multiple subjectivities". Interpretivism and pragmatism are central research paradigms when undertaking qualitative research in IS (Goldkuhl, 2012). These paradigms are discussed further by presenting a comparison between them in **Section 4.2.1.3**, followed by a description of the applicability of Pragmatism and Interpretivism to this study in **Section 4.2.1.4**.

#### 4.2.1.3. Interpretivism vs Pragmatism

This section compares Pragmatism to Interpretivism by considering the key characteristic of each paradigm, the nature of knowledge, and the type of enquiry informing each paradigm.

The key characteristic of interpretive knowledge is understanding, while pragmatism emphasizes the construction of knowledge. In pragmatism, knowledge is considered useful for action and change, with the researcher facilitating such change. In contrast, interpretivism contends that knowledge should be stimulating in itself, with the researcher being engaged in the understanding thereof (Goldkuhl, 2012). Interpretivist research focuses on creating new, richer understandings of social contexts (Saunders et al., 2019). While interpretivism and pragmatism are both inclined towards understanding, an important distinction exists between them. In interpretivism, understanding is regarded as providing value on its own, while in pragmatism, knowledge is seen as influential to change (Goldkuhl, 2012). Thus, the practical consequences of the findings contribute to the importance of the research (Saunders & Tosey, 2013). Methodologically, the main type of investigation associated with pragmatism is inquiry. Field study is the main type of enquiry in interpretivism, and data generation is carried out using interpretation (Goldkuhl, 2012).

The similarities between interpretivism and pragmatism are presented in the following section, together with their operationalization in the eModeration context.

#### 4.2.1.4. Pragmatism and interpretivism aligned to this study

Kivunja and Kuyini (2017) identify the following characteristics of research conducted within a pragmatic paradigm, which aligns with the objectives of this thesis:

- An epistemology where relationships are determined by what the researcher considers to be most suitable to the specific study being conducted;
- The ontological belief that everyone interprets reality in unique ways;
- A mixed methods methodology; and
- A value-laden axiology of conducting research to benefit people.

The following characteristics of interpretivism as outlined by (Alharahsheh & Pius, 2020) align with the objectives of this study:

- The problem articulation and development of the research are informed by the researcher's interest;

- Participants’ individual experiences in a specific context are explored in depth via qualitative methods; and

- Results are more sensitive to individual contributions and meanings.

Interpretivism and pragmatism share axiomatic elements. For instance, the axiology of both paradigms is value-driven, with the researcher’s interpretation of the results forming a core component of the research. Both paradigms require the researcher to reflexively question any underlying assumptions that could influence the outcome of the research. The similar characteristics of interpretivism and pragmatism, as outlined by Saunders et al. (2019), are depicted in **Table 4-2**. In alignment with the argument made by Saunders et al. (2009, p.109) that pragmatism is based on the notion that “the most important determinant of the epistemology, ontology, and axiology you adopt is the research question”, the operationalization of the research question articulated in **Section 1.4** is depicted in **Table 4-2** based on the epistemology, ontology, and axiology adopted in this study.

**Table 4-2: Applicability of Interpretivism and Pragmatism**

| | **Interpretivism** | | **Pragmatism** | |
|---|---|---|---|---|
| | **Characteristics** | **Operationalization** | **Characteristics** | **Operationalization** |
| **Ontology** (nature of reality or being) | Complex, rich.<br>Socially constructed.<br>Multiple meanings, interpretations and realities.<br>The fluidity of processes, experiences, and practices (Saunders et al., 2019). | Moderators and teachers have different views based on their own subjective experiences of the moderation process. Moderators and teachers thus construct their own realities based on their subjective experiences. | Complex, rich.<br>Reality is the practical outcome of ideas.<br>Fluidity of processes, experiences, and practices (Saunders et al., 2019). | The practical consequences of moderation processes influence teacher and moderator views of the process. Based on their lived experiences of the moderation process, teachers are best placed to generate design ideas that will realistically enable them to conduct moderation. |
| **Epistemology** (what constitutes acceptable knowledge) | Focus on narratives, perceptions, and interpretations.<br>Contributions: new understandings and worldviews (Saunders et al., 2019). | Teachers’ perceptions of current moderation practices were investigated via participatory design workshops. Teacher perceptions or viewpoints were used to gain an understanding of the important constructs to be used to evaluate the UX of an eModeration system. | Practical meaning of knowledge in specific contexts.<br>True theories and knowledge are those that enable successful action.<br>Focus on problems, practices, and relevance.<br>Contributions: problem-solving and informed future practice. | The design of a UX evaluation framework requires an evaluation of the requirements of teachers and moderators in the specific context of independent secondary schools. Requirements were elicited by investigating researcher and participant beliefs. The requirements informed the development of a prototype. |

| | Interpretivism | | Pragmatism | |
|---|---|---|---|---|
| | Characteristics | Operationalization | Characteristics | Operationalization |
| **Axiology** (role of values) | Value-driven research. Researchers are part of what is researched. Subjective researcher interpretations key to contribution. Researcher is reflexive (Saunders et al., 2019). | The researcher is part of the community of teachers and moderators. The researcher's own experiences informed participant activities at the workshops. Because the researcher plays a vital role in the data collection process, it is important for the researcher to reflexively engage with the theory, data, and the interpretation of the data to question any assumptions which could unintentionally influence the outcome of the study. | Value-driven research. Research initiated and sustained by the researcher's values. Researcher is reflexive. | The operationalisation of the axiology is exactly the same as the operationalization expressed in the interpretivism column. |
| Typical methods | Typically inductive. Small samples. In-depth investigations. Qualitative methods of analysis, but a range of data can be interpreted (Saunders et al., 2019). | An inductive thematic analysis process was followed to analyse data collected from two participatory design workshops. Each workshop was designed to obtain qualitative data from a small sample of cluster, regional, and national moderators. | Following research problem and research question. Range of methods: mixed, multiple, qualitative, quantitative, action research. Emphasis on practical solutions and outcomes. | Qualitative data informed the development of a prototype. User interaction with the prototype preceded quantitative and qualitative data collection from an online survey. The prototype and evaluation framework are practical solutions to the research questions articulated in **Section 1.4.** |

Lincoln and Guba (2000) argue that a combination of paradigms is possible, especially when the paradigms share similar axiomatic elements.  Van Staden (2017) and Visser (2017) are examples of published literature that provide evidence of the use of both interpretivist and pragmatic philosophies in the design of IS used in HEIs in SA. Van Staden (2017) uses interpretivism and pragmatism to underpin the evaluation of an eModeration system from a user experience perspective. Visser (2017) uses pragmatism and interpretivism to propose a methodology for the evaluation of a Management Information System.  Notably, those were not attempts at combining paradigms but rather using different paradigms as applicable to different problems addressed within the same study.

This study requires an understanding of the perspectives of educators and moderators in the evaluation of the UX of an eModeration system. Epistemologically, interpretivism is consistent with the intention of discovering the significance of events as experienced by research participants so that worthwhile improvements can occur (Forbes & Khoo, 2015). This epistemology is congruent with the PD approach taken in the co-construction of knowledge through the interaction between individuals at the PD workshops and individuals and the prototype. Interpretivism was used for the qualitative analysis of the subjective meanings that participants ascribed to their interaction with the prototype eModeration system.

An important requirement in pragmatism is that knowledge should make a difference in action (Goldkuhl, 2012), which is what the present study attempted to do by using a DSR design (see **Section 4.2.2**). DSR encourages knowledge in the service of action. DSR thus supports pragmatism as the underlying epistemological belief (Mckenney et al., 2007). The pragmatist paradigm was used to design and develop the prototype.

The following section outlines the research design, which incorporates a Participatory Design data collection strategy and a Participatory Action Design Research approach to position the user and incorporate learning and reflection within an iterative DSR design.

### 4.2.2. Research Design

#### 4.2.2.1. Design Science Research

The literature differentiates between Design Research (DR), which is a wide area covering all design fields, and Design Science Research (DSR), which has been defined as investigative practices and stances in completing IS research (Iivari & Venable, 2009; Vaishnavi et al., 2017). The difference most often conveyed is that DR is research about design, whereas DSR is principally research making use of design as a research technique. The incorporation of design within research is a central attribute of DSR (Goldkuhl et al., 2017).

##### 4.2.2.1.1. Objectives and characteristics of DSR

DSR projects are usually motivated by circumstances in the external domain within which the designed artefacts are to be integrated. The objective is to generate new artefacts to provide broader impacts to stakeholders rather than merely to develop and evaluate artefacts (Drechsler & Hevner, 2016; Myers & Venable, 2014). DSR projects address complicated real-world problems by iteratively designing new solutions to perform tasks in a specific context of use. Solving practically relevant real-world problems more effectively is an important goal in DSR

(De Villiers & Harpur, 2013; Drechsler & Hevner, 2016; Geerts, 2011). In the IS field, DSR encompasses the production of artefacts ranging from decision support systems, constructs, models, frameworks, and methods for IS evaluation to design principles, methods, and theories (Gregor & Hevner, 2013; Vaishnavi et al., 2017). The focus is on the developed artefact as well as the relevance of the artefact in the domain of application (Hevner & Chatterjee, 2010).

Despite numerous articles extolling the benefits of DSR, there have also been useful critiques. Notably, Hevner et al., (2004) and Gregory (2010), argue that Design Science researchers solve problems that are usually so specific to the implemented domain that the solution is not generalizable. Barab and Squire (2004) support this view by indicating that the claims made by researchers are grounded on the researcher's influence on the context and, as such, may not be generalizable to other implementation contexts that are not as directly influenced by the researcher. Thus, while the main objective of DSR is to provide a solution to a practical problem, this objective is achieved at the cost of the generalizability of the result and the findings. Gregor and Hevner (2013) further contend that this problem partially arises because work on DSR to a large extent views the actual creation of the artefact as the entire purpose. Consequently, little importance has been attached to the meaning of contributing to generalized knowledge. In attempting to ensure that this study was generalizable despite the researcher's views on the context, participants were engaged during each stage of the research.

DSR includes the investigation of how constructed objects are utilized and how they function to identify, clarify, and refine their behaviour (Iivari & Venable, 2009). The fundamental principle of DSR as a research method within IS, is the development of knowledge to either construct new products or to propose enhancements to current artefacts. Within academia, DSR emphasizes the information used in devising solutions rather than the design-based act of producing an artefact (Peffers et al., 2007). The defining attribute of DSR is learning via the construction of artefacts (Vaishnavi et al., 2017).

The idea of a problem and taking action to understand and describe the problem is a fundamental principle of DSR (Venable, 2014). Research activities in DSR comprise of two activities aimed at improving performance, that is, build and evaluate. Build refers to the construction of the artefact, while evaluate refers to the development of criteria against which the performance of the artefact is assessed (March & Smith, 1995).

Relevance and novelty are two important attributes of Design Science artefacts (Geerts, 2011). Thus, an artefact must firstly provide solutions to important problems. Secondly, DSR should either tackle an unresolved problem in a unique and novel way, or address a problem that has already been solved in a more effective way, to differentiate DSR from routine design (Geerts, 2011; Hevner et al., 2004).

The common elements amongst DSR researchers are the need for a concise definition of the problem prior to artefact development (Peffers et al., 2007; Sein et al., 2011), the identification of specific features and requirements of the artefact prior to design and development (Peffers et al., 2007; Venable, 2014), and an evaluation process to demonstrate rigour and the importance of establishing pertinent solutions to identified problems (Peffers et al., 2007; Peffers et al., 2006; Vaishnavi & Kuechler, 2004).

#### 4.2.2.1.2. Applicability of DSR to the eModeration context

A qualitative web-based exploratory survey of 53 respondents indicated that there is a low uptake of DSR in SA due to a lack of awareness (Naidoo et al., 2012). Naidoo et al. (2012) further posit that DSR has yet to be recognized as a reliable paradigm in computing research in SA. In contrast, subsequent studies indicate that DSR, specifically within the discipline of IS, is in fact being applied in the SA context (De Villiers & Harpur, 2013). The application of DSR, specifically to the evaluation of the user experience of an eModeration system within HEIs in South Africa, is evident in the works of Van Staden et al. (2015), Van Staden (2017) and Van Staden et al. (2019). These studies point to the relevance and suitability of DSR in the evaluation of eModeration systems in SA. Therefore, this study is not novel in its application of DSR to the eModeration context.

From the review of characteristics and concerns, it can be concluded that DSR has several significant characteristics that resonate with the objectives of this study, specifically the characteristics of learning through the building of artefacts; solving practically relevant real-world problems in a more effective way; an investigation into how designed artefacts are utilized and how they function; and the knowledge used in designing solutions. These characteristics are reflected in the Four-Cycle View of DSR (see **Figure 4-1**) as recommended by Drechsler and Hevner (2016) and in the Design Science Research Process Model (DSRPM) proposed by Vaishnavi et al. (2017), as illustrated in **Figure 4-2.**

Vaishnavi et al. (2017) maintain that research begins with an awareness of a problem. Recommendations for a solution are abductively derived from the prevailing theory base for the specific problem domain (see **Figure 4-2**).

In this study, the literature review indicated that there is no dedicated eModeration system in use in secondary schools. This finding points to a knowledge gap of eModeration systems in the secondary school environment in SA, thus creating a research problem (see **Section 1.3**). Using current information, an attempt was made to innovatively solve the problem. A provisional design (a solution) was used to implement an artefact in the Change and Impact Cycle depicted in **Figure 4-1**. Development and Evaluation (see **Figure 4-1**) are commonly performed iteratively in the Rigor Cycle of the research endeavour (see **Figure 4-1**). A functional specification is used to evaluate either partially or fully successful implementations during the Evaluation stage.

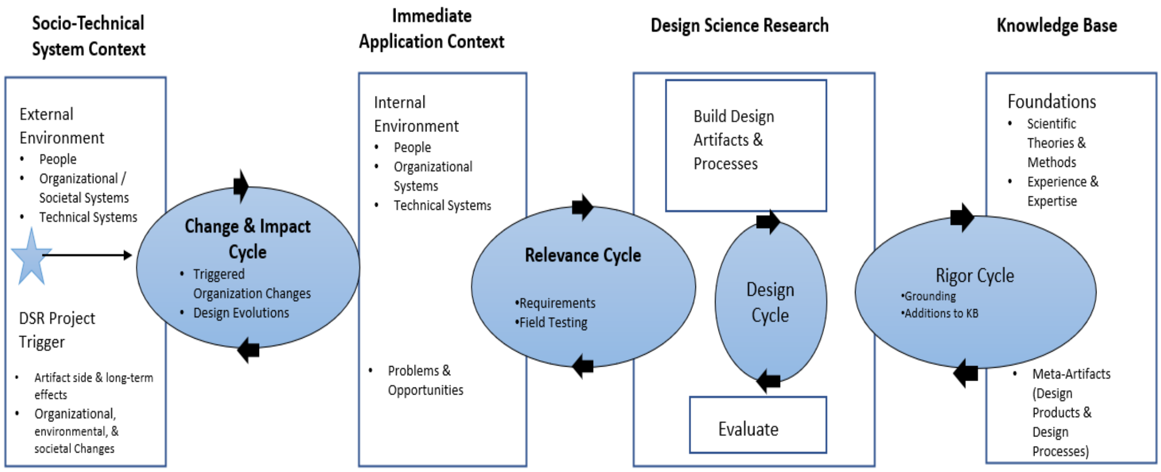



**Figure 4-1: A Four-Cycle View of the Design Science Research Process (Drechsler & Hevner, 2016)**

Development, Evaluation, and Suggestion (see **Figure 4-2**) are often iteratively executed during the research effort. The Circumscription arrows indicate the iterative flow from partially completing the cycle back to an Awareness of the Problem. Conclusion specifies the culmination of a cycle of the research process or the end of a specific Design Science Research project (Vaishnavi et al., 2017).

Consistent with the pragmatic approach of this study, the Design Cycle (see **Figure 4-1**) comprised of the logical design of an eModeration system. The software coding thereafter resulted in a prototype eModeration system that represented the first item of validation (Rigor Cycle) of the design process. This study positioned DSR in the field of IS change interventions using Design Science knowledge to develop an eModeration evaluation framework for use in South African secondary schools.

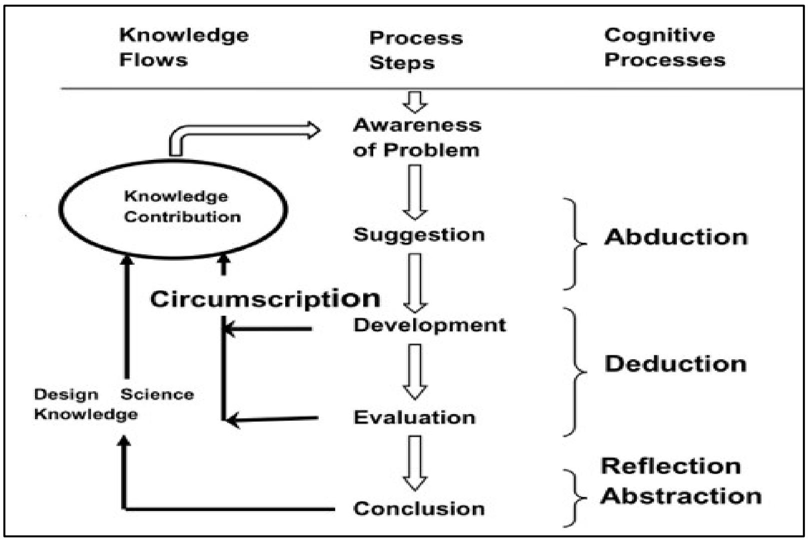



**Figure 4-2: Design Science Research Process Model (Vaishnavi et al., 2017)**

User participation is central to the developing practices that define trends in user-driven innovations (Robertson and Simonsen, 2012). However, based on a review of 31 papers, Haj-Bolouri (2015) indicates that the user is not a central concept within DSR. Given that user involvement is critical in the development of an eModeration evaluation framework, a methodology proposing the involvement of users in various stages of the DSR process is described in the following section.

#### 4.2.2.2. Participatory Design

Hansen et al. (2019) argue for understanding the role and nature of user participation in HCI research. Increased participation affords users the opportunity of playing an active role in the design process (Clemensen et al., 2017; Friedrich, 2013), increases the chances of the design meeting user needs, and increasing the chances of the system being integrated into daily work practices (Kensing & Blomberg, 1998; Robertson & Simonsen, 2012).

#### 4.2.2.2.1. Characteristics of Participatory Design

Participatory design (PD) is a methodology that promotes the participation of users in the design process of technological solutions (Clemensen et al., 2017). At the core of PD is the direct involvement of typical users of a system in the co-design of tools and products (Robertson & Simonsen, 2012). An important feature of PD is the direct engagement between the user and the researcher. Users are active participants in the design process and participants' interpretations, which contribute different layers of expertise to the final outcome, are taken into account in the research process (Muller, 1991; Spinuzzi, 2005; Wanick & Bitelo, 2020).

The engagement of multiple participants in the design process is equally beneficial to users and people developing the software. Knowledge is shared amongst researchers and practitioners, creating a wider understanding of the influence of context and values (Wanick & Bitelo, 2020). IT professionals are offered insight into user perspectives, and users are provided with the technical options available to them (Kensing et al., 1998; Muller et al., 2012).

Participants typically assume the roles of users and designers. Designers "strive to learn the realities of the user's situation while the users strive to articulate their desired aims and learn appropriate technological means to obtain them" (Hansen et al., 2019, p. 2). PD is characterized by a strong commitment to understanding practice and recognizing that the design of technology used on a regular basis shapes how people carry out their activities (Robertson & Simonsen, 2012). PD strives to make this a collaborative process so that the researcher is not positioned as an authority on the knowledge related to others (Hansen et al., 2019). Users must be afforded the opportunity of continual participation, together with the instruments for co-design at multiple stages in the process. It is necessary to repeatedly and cyclically revisit stages to stimulate critical reflection and produce implicit knowledge (Spinuzzi, 2005; Osman et al., 2009). The emphasis should be on sustained reflection with continuous member checks that extend beyond merely reacting to the functionality of the design (Spinuzzi, 2005).

Hansen et al. (2019) emphasize the right of people to participate in shaping the domain within which they act. Thus, design should generate long-term benefits for participants. Within the field of HCI end users are provided with an opportunity to test the usability of a system, in addition to becoming part of the design team. Thus system requirements and design can be iteratively refined when users are actively involved in the design process (Osman et al., 2009; Robertson & Simonsen, 2012).

##### 4.2.2.2.2. Applicability of PD to the eModeration context

Within UX, participation is viewed as the full engagement of users through the entire design process and is driven by an ongoing, systematic reflection of how users can be involved as partners in the design process (Robertson & Simonsen, 2012; Rose et al., 2017). In this study, participants engaged with the research via participatory design workshops, engagement with a prototype eModeration system, focus group interviews, and surveys.

A representative participation of moderators and teachers, who are the target users of the eModeration system, was used to ensure that the results are meaningful and relevant. This choice was informed by the fact that the researcher is part of the community of moderators. Participation of teachers and moderators was required during the initial and subsequent iterative design of the prototype via PD workshops.

A PD process was applied as a data collection strategy to a problem where no existing solution (see **Section 1.3**) was evident. Hence, before any interventions, it was necessary to determine the need for such a system, what the possible challenges are, which stakeholders would be involved, and the benefits of such a system from the relevant stakeholders. The following section discusses the alignment between the PD data capturing strategy that was adopted and the overall DSR design.

#### 4.2.2.3. Alignment between PD and DSR

The use of PD helps to articulate the specifics of a problem, namely, “What is the problem?”, “Why is it a problem?”, and “What could be done to resolve the problem?” (Clemensen et al., 2017, p. 782). Authentic engagement provides all participants with opportunities to contribute to the planning process. PD enables researchers to be certain about all issues before any practical solutions are even considered which resonates with the objective of DSR to design solutions that solve practical problems together with the people who experience those problems (Clemensen et al., 2017).

Given DSR's commitment to change and impact, users' inputs and perceptions are essential in ensuring the relevance of the artefact (Drechsler & Hevner, 2016). Design artefacts can contribute to the scientific body of knowledge while also resolving practical problems. DSR endeavours therefore require that the users of a system collaborate with researchers (Otto & Oesterle, 2012, p. 2).

PD places "human beings at the center of the design process" (Kopeć et al., 2017, p. 1086), using the actions of "explore, approximate, then refine" (Spinuzzi, 2005, p. 168) to describe how stakeholders collaboratively design systems that suit user requirements (Clemensen et al., 2017; Kopeć et al., 2017).

The points of alignment between DSR as the overarching research design and PD as a data capturing strategy are outlined below:

- Design as a research technique: DSR makes use of design as a research technique. Its focus on human creativity provides a point of intersection with PD (Clemensen et al., 2017; Spinuzzi, 2005). Creating something that does not already exist is central to the DSR process, by focusing human creativity into the design and creating artefacts that have utility in application environments (Hevner & Chatterjee, 2010). The need for knowledge sharing in the design process makes it possible to gain an in-depth understanding of users and their needs, thus increasing the importance of PD (Bødker & Pekkola, 2010). PD was positioned as a means of knowledge acquisition within DSR to make this study more relevant.

- The importance of context: DSR projects highlight the significance of context in the design process (Drechsler & Hevner, 2016), which resonates with the prominence placed on user participation in the co-design of artefacts that meet the requirements of the users in their specific context in the PD methodology (Robertson & Simonsen, 2012).

- Stakeholder involvement: The DSR objective of designing artefacts that meet stakeholder needs aligns with the objectives of PD (Drechsler & Hevner, 2016). Participants' analyses provide layers of expertise to the final result (Wanick & Bitelo, 2020), ensuring that "different voices are heard, understood and heeded" during the design process (Robertson & Simonsen, 2012, p. 6). PD was limited to the data capturing strategy during PD workshops to transfer requirements and design ideas as explained in the following section.

#### 4.2.2.4. Mapping of PD to DSR

Based on Drechsler and Hevner's Four-Cycle View of DSR (Drechsler & Hevner, 2016), the cyclical process of continual reflection and iterative development characteristic of PD supports the DSR approach taken in this study. **Table 4-3** depicts the fit between PD as outlined in **Section 4.2.2.2** and DSR based on the PD stages and the DSR processes illustrated in **Figure 4-1**.

**Table 4-3: Operationalization of mapping of PD to DSR in this thesis**

<table>
<tr><th>Stage in PD (Spinuzzi, 2005)</th><th>Mapping to DSR cycle</th><th>Focus</th><th>Operationalization</th></tr>
<tr><td>Stage 1: Initial exploration of work: designers meet users to familiarize themselves with all aspects of how users work together, including the technologies used.</td><td rowspan="2">Change and Impact Cycle<br>Relevance Cycle.</td><td rowspan="2">Emphasis is on organizational change, the "goodness of fit" of the envisaged artefact, and a general understanding of user needs and the environment in which the artefact will be deployed (Drechsler & Hevner, 2016, p. 4).</td><td rowspan="2">User needs were elicited from a systematic literature review.</td></tr>
<tr><td>Stage 2: Discovery processes: designers and users clarify the users' goals to agree on the desired outcome.</td></tr>
<tr><td>Stage 2: Discovery processes</td><td rowspan="3">Relevance Cycle<br>Design Cycle<br>Rigor Cycle.</td><td rowspan="3">Designers attempt to understand the work environment. Artefacts are iteratively designed for the specific context in which the artefact will be implemented.</td><td>Relevance Cycle: the need for an artefact was articulated as eModeration requirements, based on the literature review and participant comments during Workshop One.</td></tr>
<tr><td rowspan="2">Stage 3: Prototyping - technological artefacts are iteratively shaped to fit into the envisioned work environment. Working prototypes using the inputs of one or more users may be conducted in situ. (Robertson & Simonsen, 2012).</td><td>Relevance and Design Cycles: Data collection during workshop 2 (Appendix C).</td></tr>
<tr><td>Rigor Cycle: applicable knowledge obtained from the literature was triangulated with empirical data from teachers' inputs at the PD workshops.</td></tr>
</table>

The stages are repeatedly revisited in the PD methodology, thus facilitating information flow between Stages 1 and 2 and Stages 2 and 3, which align with the information flow in the iterative process of DSR.

#### 4.2.2.5. Positioning the user within DSR

Researchers concur that IS research should not only make theoretical contributions, but also solve problems for stakeholders (Sein et al., 2011). Considering this duality and the challenge of ensuring the relevance of the artefact, it is necessary to acknowledge that IT artefacts are interdependent on the people and social contexts in which they are used to meet stakeholder needs (Hevner et al., 2004). Given that user perceptions and fit with an organization are crucial to the successful development and implementation of an IS (Hevner et al., 2004), Sein et al. (2011) propose that there should be a strong relationship between the research activities of building, intervention, and evaluation and the extensive participation of key stakeholders such as researchers and users of a system.

In line with Haj-Bolouri's (2015) recommendation that researchers should seek answers to how users can be positioned within the research methodology, the following factors were considered in this study. First, Research Question three (see **Section 1.4**) sought to determine how secondary school teachers could contribute to the design and validation of a user experience eModeration evaluation framework. Secondly, it was necessary to determine the effect of the design of an eModeration evaluation framework on all stakeholders. Lastly, in attempting to claim generalizability, it was necessary to include all possible stakeholders in all stages of the design process. This was done by involving IT examiners, teachers, moderators, and members of an assessment body in the initial stages of gathering design and functional requirements during two PD workshops. The eModeration prototype was tested by teachers and moderators of one private school who provided feedback on their impressions of the eModeration prototype system via an online survey and focus group discussions. Finally, a representative sample of national examiners, moderators, members of an assessment body, and an ICT manager validated the eModeration evaluation framework.

#### 4.2.2.6. Action Design Research

Action design research (ADR) is a genre of DSR that combines action research (AR) and design research (DR) (Gregor et al., 2020; Mullarkey & Hevner, 2019). Design is viewed as a situated process occurring within an organizational context as well as a reflective process to generate prescriptive design knowledge of the artefact (Gregor et al., 2020). Action researchers engage with "lived problems" to evaluate an artefact by means of its effect on the participant within specific sociocultural contexts (Hathcoat & Nicholas, 2014, p. 5; Botes & Goede, 2014). Bilandzic and Venable (2011) further propose a Participatory Action Design Research (PADR) method that combines AR and DSR approaches, as is briefly outlined in the following section.

#### 4.2.2.7. Participatory Action Design Research

Participatory action design research (PADR) consists of five activities, as depicted **in Figure 4-3**.

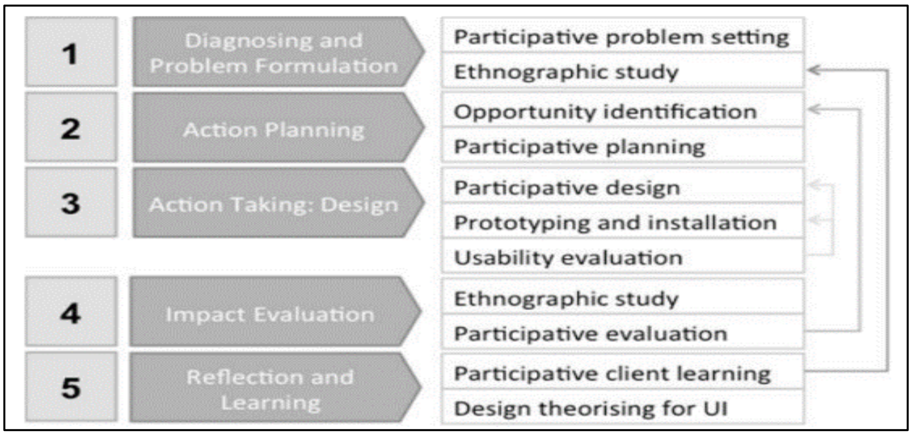



**Figure 4-3: Participatory Action Design research (Bilandzic & Venable, 2011)**

The activities of diagnosing, action planning, action taking design interventions, impact evaluation and learning, and creation of actionable knowledge encourage the development and evaluation of artefacts in close collaboration with stakeholders. Such collaboration leads to richer and more relevant requirements for artefact improvement (Bilandzic & Venable, 2011).

#### 4.2.2.8. Participatory Action Design Research approach (PADRE)

Drawing on the works of Bilandzic and Venable (2011) and Mullarkey and Hevner (2019), Haj-Bolouri et al. (2016) propose a Participatory Action Design Research (PADRE) approach which is an elaborated version of ADR. PADRE advocates for the integration of a reflection of learning into every stage of the ADR model. Learning, in each cycle, is determined by the implementation of the “plan”, “implement”, “evaluate”, and “reflect” cycles. Learning occurs as a result of the compiled knowledge from each iterative cycle, and is thus not reflected as a separate stage (Haj-Bolouri et al., 2016).

#### 4.2.2.9. Alignment between DSR and PADRE

Considering the importance of stakeholders in the eModeration context, the inclusion of stakeholders in all cycles of the DSR process was an imperative. To contextualize the problem and to provide a contextualized solution, it was necessary to consider the entry points of stakeholder involvement in the various stages of DSR. The DSR process depicted in **Figure 4-1** provides a conceptual representation of the cycles iterated in the DSR process. It was necessary to provide a practical approach to its implementation and to incorporate a reflection of learning at each stage.

ADR is acknowledged as an approach to implementing DSR and, based on the application of PADRE to ADR in involving users in the research process as demonstrated by Haj-Bolouri et al. (2016), the cycles of the PADRE approach were iterated within each cycle of the DSR process (see **Figure 4-4**) to involve stakeholders and incorporate a reflective process during data collection and evaluation.

The insights gained were documented at each stage of the PADRE process, as recommended by Haj-Bolouri et al. (2016). A core concept of PD (**Section 4.2.2.2**) is the “genuine participation” of the user in generating design ideas (Cozza et al., 2020, p. 274). Accordingly, PD was confined to data capturing of requirements and design ideas during two PD workshops, and the PADRE approach was used to plan, implement, evaluate, and reflect on the insights gained from the data collected and analyzed during the DSR process.

The components and stages of the PADRE process as applicable to this study are discussed in the following sections. **Figures 4-5** to **4-9** have been adapted from the stages of the PADRE process illustrated by Haj-Bolouri et al. (2016).

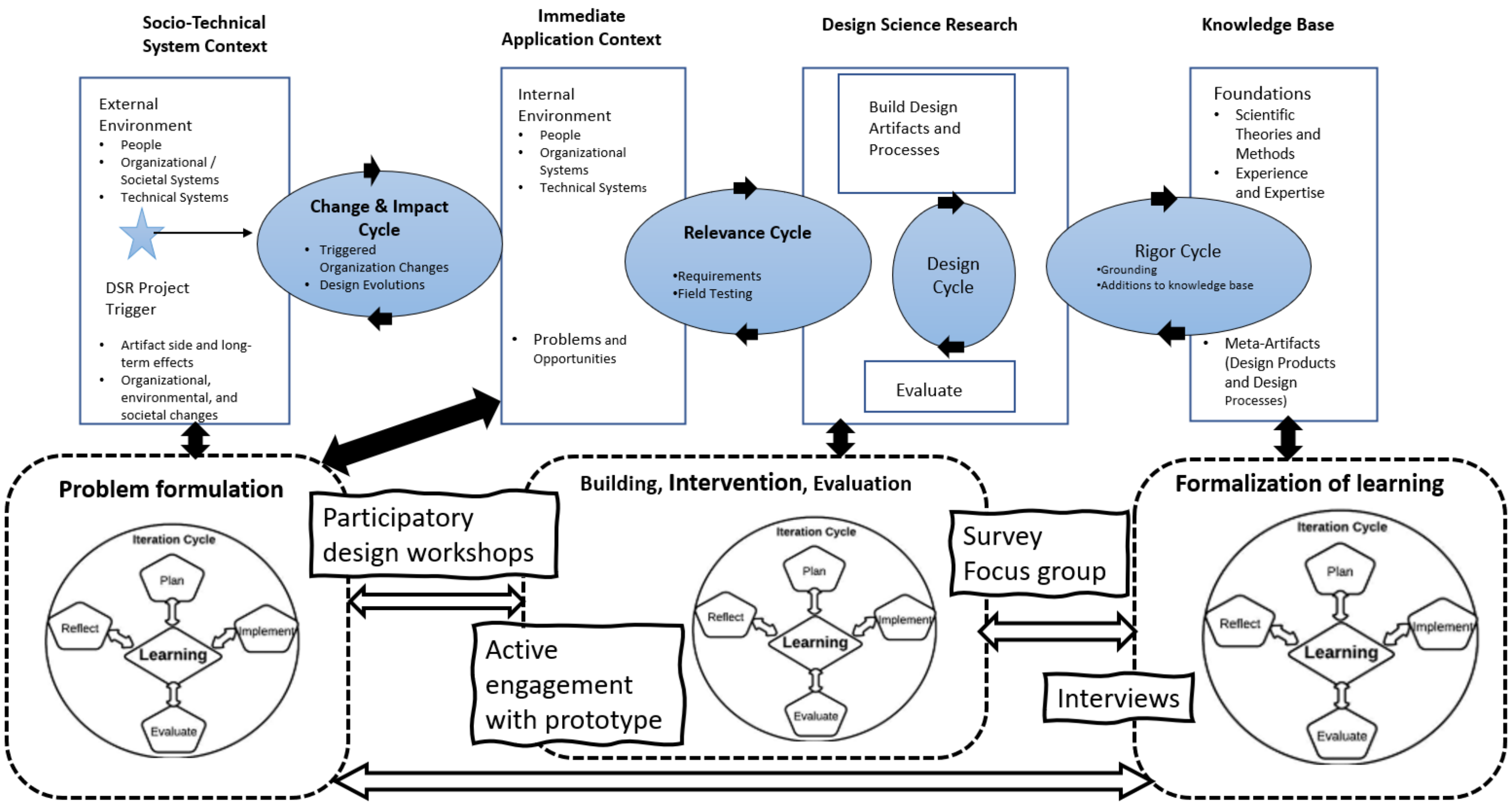



**Figure 4-4: Mapping of PADRE to DSR (Drechsler & Hevner, 2016; Haj-Bolouri et al., 2016)**

➢ **Problem formulation**

The first component of the PADRE cycle is problem formulation (see **Figure 4-5**), which occurred in the Change and Impact and Relevance cycles of DSR.

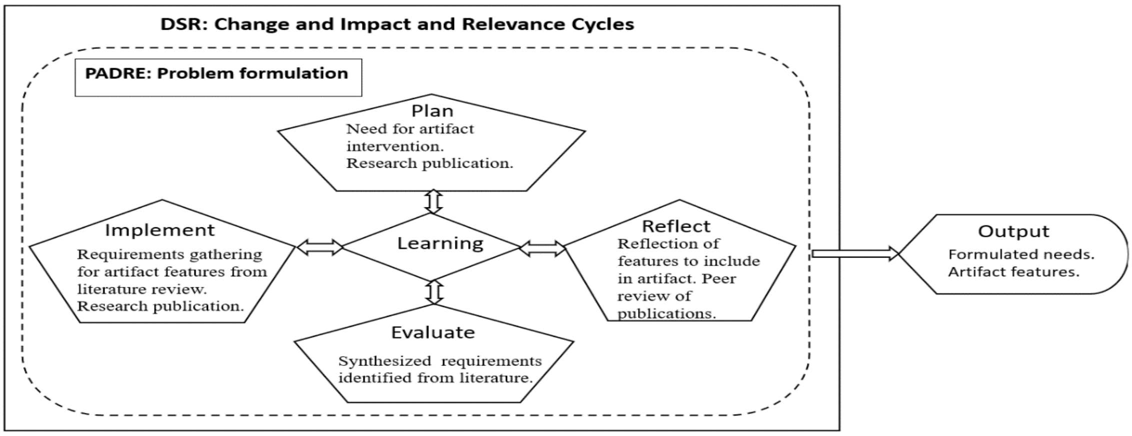



**Figure 4-5: Problem formulation**

An awareness of the problem was triggered by a literature review pointing to a lack of dedicated eModeration systems in secondary schools. Consequently, during the Problem formulation component, the first stage (Plan) consisted of an articulation for the need to develop an artefact to evaluate an eModeration system (Rajamany, 2020). The second stage (Implement) consisted of a systematic literature review to formulate a problem statement, identify gaps in the literature, gather the requirements of an eModeration system, and determine the user experience constructs of an eModeration system. During this stage, a research article on the requirements of an eModeration system (Rajamany et al., 2020b) and an article on trends regarding the implementation of eModeration systems were published (Rajamany et al., 2021). The third stage (Evaluate) resulted in the synthesis of the eModeration system requirements and user experience constructs from the existing literature. The last stage (Reflect) included the compilation of a list of features of an eModeration system together with user experience constructs from an analysis of technology acceptance models, the field of HCI, and the field of IS success models. A reflection on the identified features and user experience constructs resulted in the identification of features to include in an eModeration system.

➢ **Building**

During the Building component of the PADRE cycle (see **Figure 4-6**), which occurred during the Design Cycle of DSR, planning consisted of the design of two participatory design workshops to actively engage stakeholders in contributing design requirements and specific functional needs relating to the development of a prototype eModeration system.

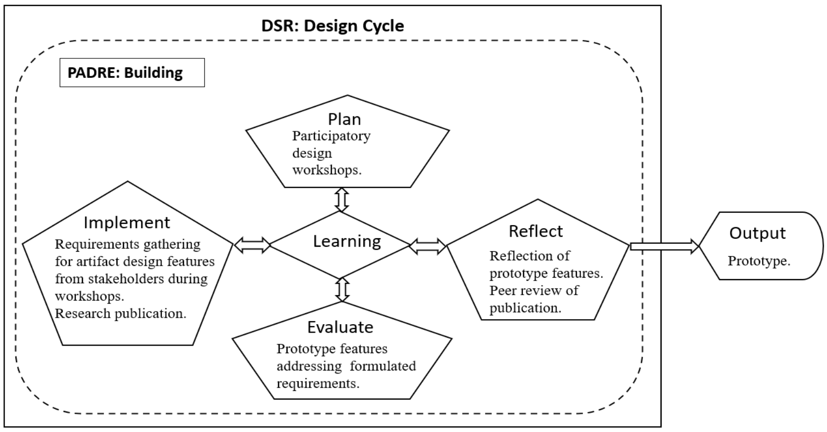



**Figure 4-6: Building component of PADRE**

During the "Implement" stage, participants answered questions on the requirements and design of an eModeration system, based on their knowledge and roles (e.g., teacher, moderator, examiner, assessment body). The articulated requirements and design ideas were documented in a peer reviewed article and implemented through a prototype eModeration system (Rajamany et al., 2022), developed from an analysis of the learning and reflection of the requirements elicited from the systematic literature review as well as the participatory design workshops.

The evaluation stage comprised of an online survey to confirm how well stakeholder requirements were met and to compile additional stakeholder functional specifications. The reflection and learning from the implemented prototype and a peer review of the publication resulted in revised functional specifications based on the user experience and articulated stakeholder needs.

➢ **Intervention**

The Intervention component of the PADRE cycle (see **Figure 4-7**) occurred during the Design Cycle of DSR. Methods of distributing links to the eModeration prototype to teachers in a private secondary school where the eModeration prototype was implemented were considered during the planning stage.

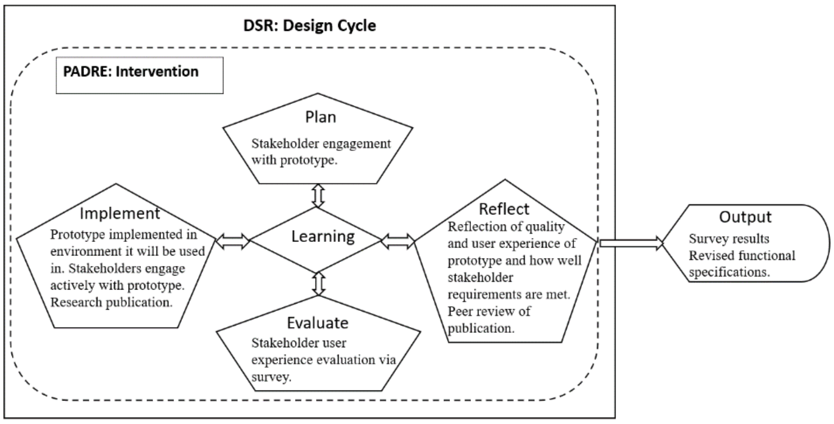



**Figure 4-7: Intervention component of PADRE**

During the implementation stage, teachers and moderators actively engaged with the eModeration prototype so that the user experience could be evaluated. The evaluation phase comprised of an analysis of the data around stakeholder perceptions of the user experience and functionality of the eModeration prototype. Reflection and learning resulted in conclusions around the quality and user experience of the functionality of the eModeration prototype as well as the effectiveness with which stakeholder needs were addressed. Stakeholders' evaluation of the eModeration prototype generated learning around the user experience and functionality of the prototype. The revised functional specifications were an outcome of the reflection and learning from stakeholder responses to the survey and a peer review of the publication that documented an analysis of stakeholders' user experience (Rajamany et al., 2022).

- **Evaluation**

During the evaluation component of the PADRE cycle (see **Figure 4-8**), which occurred during the Design Cycle of DSR, the planning stage consisted of the development of focus group interviews to corroborate the findings from the online survey.

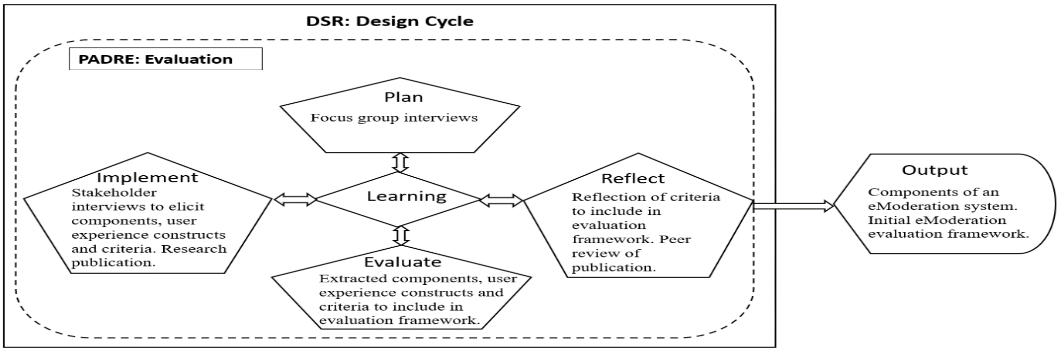



**Figure 4-8: Evaluation component of PADRE**

During the Implement stage, stakeholders were interviewed in groups (based on the subjects taught) to elicit domain-specific criteria for the development of an eModeration evaluation framework. The interview results were documented in a journal article and presented for peer review. During the Evaluate stage, the statistical analysis of the survey data, triangulated with an analysis of the focus group interview findings, contributed to the compilation of the components, user experience constructs, and criteria to include in an eModeration evaluation framework. The reflection and learning from the analysis of the data and the peer review of the publication resulted in the development of an initial eModeration evaluation framework.

- **Formalization of learning**

During the Formalization of learning component of the PADRE Evaluation Cycle (see **Figure 4-9**), which occurred during the Rigor Cycle of DSR, criteria for evaluation of the eModeration framework were extracted from a literature review of criteria commonly used in the evaluation of DSR artefacts was conducted during the planning stage. Semi-structured interview questions were formulated using the criteria for evaluation as a focal point.

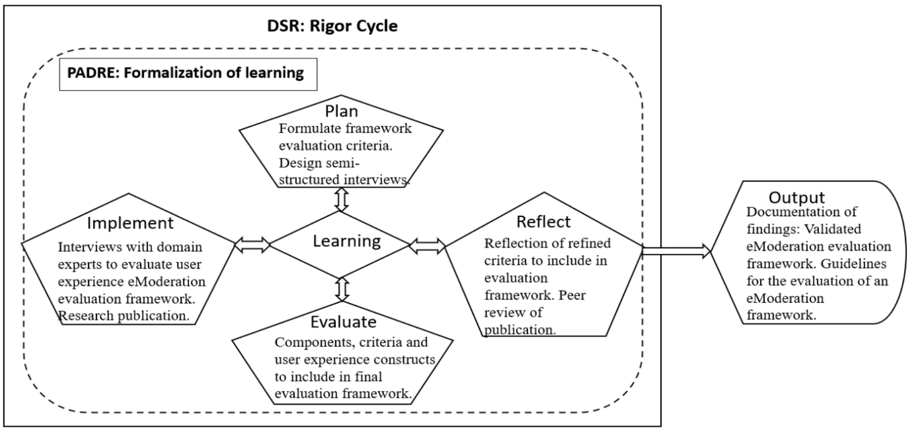



**Figure 4-9: Formalization of learning component of PADRE**

During the Implement stage, interviews were conducted with domain experts. During the evaluate stage, responses to the interviews were analyzed to validate the components, criteria, and user experience constructs to include in the final evaluation framework. In collaboration with interviewees, a determination was made that the learning outcome was satisfactory, and that no further iterations were required. The reflection and learning arising from the evaluation of the final criteria resulted in a validated eModeration evaluation framework together with guidelines for the evaluation of an eModeration system, which were documented and communicated in this study.

### 4.2.3. Research Method

Crotty (1998, p. 3) defines research methods as "the techniques or procedures used to gather and analyse data related to some research question or hypothesis". The types of questions to be answered; the degree of influence over behavioural outcomes, and the level of attention to current events are factors that govern the most appropriate research method to use (Wedawatta et al., 2011). Of these factors, the type of research question to be answered is the most significant in determining the best research method to adopt. The research questions identified for this study, together with the strategies for answering them, are specified in **Table 4-4**.

**Table 4-4: Operationalization of the Research Questions**

| Research question | | Objective | Strategy | Outcome |
|---|---|---|---|---|
| **RQ1** | What are the components of an eModeration system? | To determine what components exist for the digital moderation of assessments. | Literature Review | Chapter Two. **Table 2-9.** |
| **RQ2** | What are the criteria that can be used to evaluate the user experience of an eModeration system? | To elicit criteria that can be used as a basis for crafting a framework to evaluate the user experience of an eModeration system. | Literature Review<br>Survey<br>Focus group interviews<br>Data analysis | Chapters Two – Seven. **Table 7-1. Table 7-2.** |
| **RQ3** | How can independent secondary school teachers contribute to the design and validation of a user experience evaluation framework for an eModeration system? | To involve teachers in the design and validation of a framework for evaluating an eModeration system. | Framework evaluation<br>Qualitative and quantitative data Analysis | Chapters Five - Seven. **Table 8-5.** |

A DSR approach was used to develop an evaluation framework for the User Experience (UX) of an eModeration system. Participants' perceptions from their initial interaction with the prototype were used to generate new insights and ideas for the evaluation criteria.

#### 4.2.3.1. Data collection

PD workshops, questionnaires distributed via an online survey (see **Appendix E**), and focus group interviews (see **Appendix F**) were used to collect data. The data collection strategy employed in this study obtained data within the phases outlined in **Section 1.6.2**:

- Phase 1: Literature review and data collection
  - A literature review was conducted to extract eModeration system requirements.
  - Qualitative data was collected from 16 participants during two PD workshops with teachers and IT moderators to extract the functional needs of an eModeration system and design ideas for Version 2 of a prototype eModeration system.
  - Quantitative and qualitative data were collected through an online survey.
- Phase 2: Prototype evaluation

- Qualitative data was collected from focus group interviews after teacher interactions with the revised prototype.

➢ Phase 3: Evaluate the framework

- Expert interviews towards validating the eModeration evaluation framework.

The following sections describe the specific techniques employed in gathering data for each of the phases outlined above. **Section 4.2.3.2** describes the participatory design workshops. **Section 4.2.3.3** presents the development of the data collection instrument.

#### 4.2.3.2. Participatory Design workshops

The following sections present the sampling method, the participant demographics, and the structure of the participatory design workshops.

##### 4.2.3.2.1. Sampling method

A purposive sampling technique was used to select participants. Purposeful sampling is a non-random technique commonly used in qualitative research to identify and select “information-rich” cases (Palinkas et al., 2016, p. 533). Participants who are proficient and well-informed about the problem are chosen based on specific characteristics to “capture the diversity within a population” (Patton, 2015, p. 403).

Purposive sampling does not require any underlying theories or a specific number of participants (Etikan et al., 2016). Participants are chosen based on their knowledge and experience, availability, willingness to participate, and the ability to communicate experiences and opinions in an “articulate, expressive, and reflective manner” (Etikan et al., 2016, p. 2; Palinkas et al., 2016). In this way, purposive sampling leads to greater depth of information from a smaller number of expert participants in a convenient and cost-effective way (Teddlie & Yu, 2007; Rahi, 2017).

##### 4.2.3.2.2. Participant demographics for Participatory design workshops

Domain experts were chosen to engage in PD workshops based on their proficiency and experience of moderation processes. Importantly, these participants were available and willing to participate, thus providing a rich sample of teachers and moderators. The participant demographics are depicted in **Table 4-5**. Although 16 people participated, only 12 of the participants provided personal information.

**Table 4-5: PD workshops participant demographics (N = 12)**

| | | |
|---|---|---|
| **PRIMARY ROLE** | IT Educator | 100% |
| **SECONDARY ROLE** | Cluster moderator | 33,3% |
| | Regional moderator | 41,7% |
| | National moderator | 16,7% |
| | Examiner | 8,3% |
| **Experience as moderator** | < 1 year | 8,30% |
| | 1 - 5 years | 16,7% |
| | 6 - 10 years | 8,30% |
| | > 10 years | 50% |
| **Age** | 25 - 34 | 16,7% |
| | 35 - 44 | 41,7% |
| | 45 - 54 | 41,7% |

#### 4.2.3.2.3. Structure of workshops

Two PD workshops were completed on two consecutive days in November 2021 (see **Appendix B**). Participants worked in four groups of between three and four participants to complete several activities. Participants firstly worked individually to answer five pre-defined questions ranging from determining the need for an eModeration system to detailing the functionality that they would include in such a system. Thereafter, participants worked in their groups to brainstorm ideas for the most important functionality that would be required.

### 4.2.3.3. Data Collection Instruments

An online survey was used as a data collection technique to determine educators' perceptions of how previously identified constructs contribute to the UX of an eModeration system.

#### 4.2.3.3.1. Questionnaire considered

The following questionnaires were isolated for consideration, based on the usability and user experience focus of this research: System Usability Scale (SUS), User Experience Questionnaire

(UEQ), The Usefulness, Satisfaction, and Ease of Use Questionnaire (USE), and the Computer System Usability Questionnaire (CSUQ). A brief overview of each questionnaire follows.

- SUS

System Usability Scale (SUS) is a mixed-tone, ten statement questionnaire for subjectively assessing the usability of a system (Lewis & Sauro, 2009; Lewis, 2018). Each question has a five-point scale ranging from Strongly Disagree to Strongly Agree. The SUS is highly reliable (alpha = 0.91) and can be used by a broad group of usability practitioners to evaluate almost any type of user interface because it is technology agnostic (Bangor et al., 2009). The SUS has excellent reliability (coefficient alpha typically exceeds .90), validity, and sensitivity to a wide variety of independent variables (Sauro & Lewis, 2016).

- User Experience Questionnaire UEQ

The User Experience Questionnaire (UEQ) is a widely used questionnaire for measuring users' subjective impressions of a system (Devy et al., 2017; Hinderks et al., 2018; Schrepp et al., 2017b). The main goal of the UEQ is a fast and direct measurement of UX (Schrepp et al., 2017a), considering aspects of pragmatic and hedonic quality (Devy et al., 2017; Schrepp et al., 2014).

The questionnaire consists of 26 items grouped into six scales, each of which represents a distinct UX quality aspect (Schrepp et al., 2017a). The reliability (i.e., the consistency of the scales) and validity (i.e., that the scales really measure what they intend to measure) of the UEQ scales were investigated in several usability tests. These studies showed a sufficient reliability of the scales (measured by Cronbach's Alpha). Additionally, several studies have shown a good construct validity of the scales (Schrepp et al., 2017a).

- Usefulness, Satisfaction, and Ease of Use Questionnaire (USE)

The Usefulness, Satisfaction, and Ease of Use Questionnaire (USE) is a valid, reliable instrument and easily accessible questionnaire (Faria et al., 2016) that measures the subjective usability of a system (Lund, 2001). USE can be applied to various scenarios of usability assessment because it is non-proprietary and technology-agnostic (Lund, 2001; Faria et al., 2016; Gao et al., 2018). The immediate consequence of the data to the organization, for instance, "Can users successfully complete the task?” and “What problems did they have?”, means that raw data from even a small sample of typical users could be extremely useful in identifying a need for design changes (Bevan, 1995, p. 120).

- The Computer System Usability Questionnaire (CSUQ)

The Computer System Usability Questionnaire (CSUQ) can be used across different user groups and research settings for measuring users’ subjective opinions in a “scenario-based situation” (Assila et al., 2014, p. 470). CSUQ has been successfully applied in academic and practical contexts, and is relevant and applicable to usability evaluations in various research contexts (Assila et al., 2014). The items produce four scores measuring the user’s overall impression of the system, in addition to the system usefulness, information quality, and interface quality.

#### 4.2.3.3.2. Justification for choice of questionnaires based on study context

The choice of questionnaire depends on the quality aspects to measure. This study investigated UX with a focus on usability. It was therefore necessary to employ questionnaires that focus on both the usability and the UX aspects of an eModeration system. This section presents a rationale for disregarding the SUS questionnaire, followed by a justification for the UEQ and its applicability to the eModeration context. Next, a motivation for using the USE questionnaire is provided. Lastly, a discussion on how questions were adapted from the USE and CSUQ questionnaires in the final questionnaire disseminated to participants is provided.

SUS and CSUQ are widely used questionnaires for assessing perceived usability (Lewis, 2018). The SUS questionnaire, while easy to use and freely available, has limitations in its scoring method and the results it provides are too general (Devy et al., 2017). For a deep analysis, specific items are needed to measure user experience attributes, making the SUS unsuitable for this study that focuses on measuring user experience with a focus on usability (Santoso et al., 2016). Therefore, the SUS was not considered further.

CSUQ scores are sensitive to independent variables such as experience with the computer system, type of computer used, and range of experience with different computers, and user groups of varying experience (Lewis, 2019). In this study, teachers have varying degrees of experience. The CSUQ would therefore be pertinent.

Over the years, the usability approach has shifted from the testing and evaluation of completed artefacts to incorporating usability evaluation into the design phase of software development. ISO definitions of usability have evolved to accommodate this shift and have been revised to include product quality and usability characteristics (Chung & Sahari, 2015). This move has led to the notion of understanding usability based on user experience, which is the stance taken in this study (see **Section 2.5.3.6**). The USE questionnaire measures the utilitarian as well as the experiential attributes of a product with a focus on the utilitarian aspect (Chung & Sahari, 2015).

The USE questionnaire analyses and summarizes the usability of a system based on the usefulness, ease of learning, satisfaction, and ease of use constructs of usability (Gao et al., 2018). Anecdotal evidence and a literature review point to the importance of these factors for an eModeration system, which should be used voluntarily, be easy to learn quickly, and be used without negatively impacting on teachers' time (Van Staden, 2017). Participants are provided with opportunities to make qualitative comments, which is particularly important to provide useful feedback on the UX of the system.

Consistent with Schrepp et al's. (2017a) recommendation that it makes sense to use more than one questionnaire for broader evaluations, this thesis made use of two questionnaires (CSUQ and USE) to evaluate the usability and adopted the UEQ to measure the UX of the prototype eModeration system. In alignment with the theoretical framework (see **Figure 3-14**), questions from the CSUQ were added to the USE questionnaire to cover information quality, as discussed below.

While the UEQ has the disadvantage of only providing high level detail of the strengths and weaknesses of a product, it is possible to make concrete improvements of the eModeration prototype by using the different scales describing the distinct quality components (Schrepp et al., 2014). The ready availability of the UEQ benchmark and the ease of use of the provided data analysis tool strengthened the motivation for using the UEQ (Santoso et al., 2016; Schrepp & Thomaschewski, 2020).

The time a participant is willing to spend on answering questions for a UX evaluation is typically quite limited (Hinderks et al., 2018). Therefore it is important to use questionnaires with few items that can be answered swiftly. The UEQ consists of 26 items, which requires a total of about 3 to 5 minutes to answer (Hinderks et al., 2018). This is especially convenient, given that personal evidence and literature findings point to teachers being under immense pressure to complete administrative tasks timeously (Chung & Sahari, 2015).

Having established the suitability of the CSUQ, USE, and UEQ questionnaires to the eModeration context, it was necessary to determine their value in terms of the underlying theoretical constructs (see **Figure 3-14**). In aligning the questions to the theoretical framework and the data that emerged from the literature review and PD workshops, the CSUQ and USE questionnaires were adapted for the purposes of this research, as discussed below.

Quality in use factors were used as a basis for the derivation of constructs in the theoretical framework. In alignment with the theoretical underpinning of this study (see **Figure 3-14**), information quality from CSUQ was combined with ease of use from the USE questionnaire. Interface quality from CSUQ was combined with satisfaction from the SUS questionnaire. Flexibility was not included in the USE questionnaire. Additional questions were thus formulated, based on data that emerged from PD workshops and the literature review. System usefulness constructs were categorized and integrated into satisfaction, efficiency, and learnability. An interrogation of the seminal literature in UX, for instance, Forlizzi & Battarbee (2004), Hassenzahl (2003, 2008), and Hassenzahl and Tractinsky (2006) do not provide evidence of the term user friendly (as discussed in **Section 2.5.3.1**) being used in the field of HCI. User friendly was thus removed from the questionnaire. The UEQ was used in its entirety to determine the UX of the eModeration prototype.

## 4.3. Data Analysis

Law and Sun (2012) contend that a mixed-method approach is especially pertinent to UX studies, due to the subjective and dynamic nature of UX. Similarly, Law et al. (2014) argue that qualitative data provides a richness and detail that may be absent from quantitative measures. A combination of qualitative and quantitative methods offers scholars the best of each method. Thus, the strengths of the one method offset any shortcomings that may exist in the other (Pansiri, 2005; Creswell, 2007; Mckenney et al., 2007; Venkatesh et al., 2013). A quantitative data analysis supplemented the qualitative data analysis in this study to enable triangulation of the data to deliver more relevant and impartial results.

Triangulation can be explained as the combination of disparate methods in the study of equivalent phenomena to enable validation of the data, thus providing greater credibility to the conclusions. In this study, the collection and analysis of quantitative data were integrated with the evaluation of qualitative data from two PD workshops and focus group interviews (see **Figure 1-4**; Phases one and two). The findings from the quantitative data analysis were utilized to interpret, ratify, and improve on the results from the qualitative data analysis to answer the research questions (see **Table 4-4**).

Thematic analysis (discussed further in **Section 5.3.1**) was chosen for the qualitative data analysis due to its wide applicability across all qualitative designs.

## 4.4. Research quality and rigour

Rigour of quantitative data is measured by the reliability of the measuring instrument. The following sections demonstrate the application of rigour in this study, beginning with the reliability of the quantitative data collection instrument.

### 4.4.1. Reliability of quantitative data

Since items of the standardized questionnaires were adapted and categorized based on the identified usability constructs (see **Section 4.2.3.3.1**), it was necessary to determine the validity and reliability of the questions. A pre-test of the questionnaire was performed with two technology teachers to determine the contextual relevance and ease of understanding. The teachers' suggestions regarding the grammar and the duplication of one question were implemented. The construct reliability was tested with item analysis using the Cronbach alpha coefficient, as discussed in the following section.

#### 4.4.1.1. Reliability of measuring instrument

The internal consistency (reliability) of a questionnaire is explained as the "degree of consistency between different items of the same construct" (Bhattacherjee, 2022). The extent to which participants of a study rate multiple-item constructs in a similar way provides a reflection of the construct's internal consistency. Although other measures exist, the Cronbach Alpha (CA) coefficient is the most widely used measure to assess the reliability of the different constructs in a questionnaire (Gadermann et al., 2012; HR-Statistics, 2016; Gerber, 2020). The interpretation of the reliability of the overall CA value is depicted in **Table 4-6**.

**Table 4-6: Interpretation of Cronbach Alpha coefficient values**

| CA Value | Interpretation |
|---|---|
| >0.8 | Good reliability |
| >=0.6 and <= 0.8 | Acceptable reliability |
| <0.6 | Unacceptable reliability |

A reliable CA value verifies that the individual items of a construct consistently measure the same construct. The overall CA of the usability constructs measured in this thesis are depicted in **Table 4-7**. Questions 1 to 10 focused on the biographical details of participants. Therefore, only the reliability of Questions 11 to 18 are reported on in **Table 4-7**.

**Table 4-7: Overall Cronbach Alpha (CA) coefficient reliability**

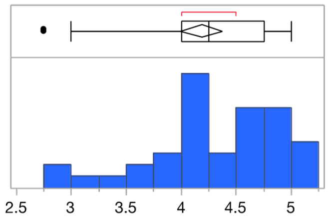
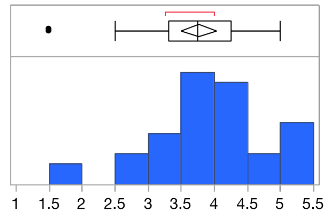
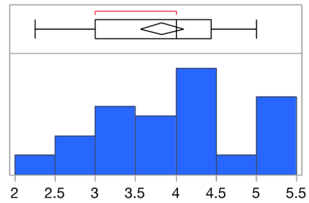
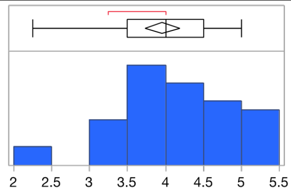
| | **Construct** | **Items** | **Items left out** | **CA coefficient** | **Reliability interpretation** | **Skewness** | **Mean** | **Std Deviation** |
|---|---|---|---|---|---|---|---|---|
| **Usability** | Ease of use | 11.1 – 11.4 | None | 0.78 | Acceptable | -0.51 | 4.19 | 0.6 |
| | Effectiveness | 12.1 – 12.4 | None | 0.87 | Good | -0.45 | 3.77 | 0.85 |
| | Efficiency | 13.1 – 13.4 | None | 0.81 | Good | -0.12 | 3.83 | 0.84 |
| | Satisfaction | 14.1 – 14.4 | None | 0.9 | Good | -0.44 | 3.96 | 0.71 |
| | Learnability | 15.1 – 15.4 | None | 0.86 | Good | -0.55 | 4.33 | 0.57 |
| | Flexibility | 16.1 – 16.4 | None | 0.73 | Acceptable | 0.15 | 4.03 | 0.57 |
| | Information quality | 17.1 – 17.4 | None | 0.78 | Acceptable | -0.21 | 4.00 | 0.59 |
| **User experience** | | 18.1 – 18.25 | None | 0.96 | Good | -0.06 | 5.50 | 0.98 |

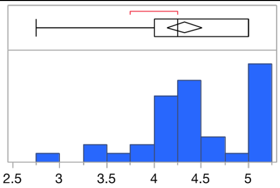
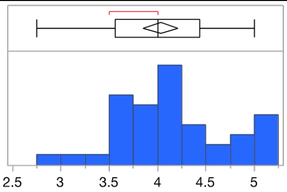
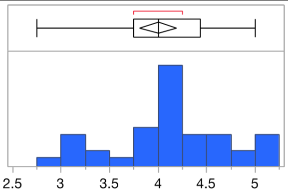
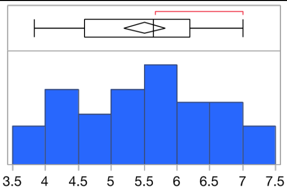
The reliability estimates for ease of use, flexibility, and information quality of 0.78, 0.73, and 0.78, respectively, indicated acceptable reliability. The reliability estimates for effectiveness, efficiency, satisfaction, and learnability all exceeded 0.8, indicating good reliability. The mean of 4.19, with a standard deviation of 0.6, indicates that the scores ranged from neutral to strongly agree in response to Questions 11.1. to 11.4. (see **Appendix E**). Considering the good reliability for effectiveness, efficiency, satisfaction, and learnability, and the acceptable reliability for ease of use, flexibility, and information quality, it was concluded that these usability constructs should be included in the design of an eModeration evaluation framework.

#### 4.4.1.2. Normality of measuring instrument

Assumptions for the statistical techniques were tested by assessing the skewness and inspecting the histograms for all constructs, as depicted in **Table 4-8**. The range of skewness for all constructs was between -1 and +1, which some authors use to accept normality (Gerber, 2020).

**Table 4-8: Distributions for each construct**

| CONSTRUCT | HISTOGRAM | SKEWNESS |
|---|---|---|
| Ease of use |  | -0.740312 |
| Effectiveness |  | -0.710518 |
| Efficiency |  | -0.121421 |
| Satisfaction |  | -0.435976 |

| CONSTRUCT | HISTOGRAM | SKEWNESS |
|---|---|---|
| Learnability |   | -0.551219 |
| Flexibility |   | 0.1530561 |
| Information quality |   | -0.208317 |
| User experience |   | -0.063069 |

There was a symmetric distribution for efficiency, satisfaction, flexibility, information quality, and user experience, which indicates that most responses were neutral. Learnability, effectiveness, and ease of use were moderately skewed, that is, more respondents found the eModeration prototype to be easier to learn, effective, and easier to use. Based on the histograms and skewness levels, the deviations from normality were not severe; therefore, the assumptions for statistical techniques were satisfied.

### 4.4.2. Validity and reliability of qualitative data

The quality of the research is based on validity and reliability, and is assessed based on the qualitative criteria of trustworthiness, authenticity, and adequacy (Morse et al., 2002; Shenton, 2004; Yilmaz, 2013). Furthermore, trustworthiness has four aspects, namely, credibility, transferability, dependability, and confirmability (Smith, 2011).

Credibility, transferability, dependability, and confirmability are viewed as the qualitative equivalents to the quantitative criteria of internal validity, external validity and generalizability, reliability, and objectivity, respectively (Morrow, 2005; Shenton, 2004). The following measures demonstrate the application of rigour in this study.

A pilot study was initially conducted amongst a sample group of three participants to test the validity and reliability of the PD workshops and to refine the data collection strategy by streamlining the activities of the workshops.

The following elements of trustworthiness were ensured.

- Credibility: In research located within the interpretivist paradigm, credibility refers to "the extent to which data and data analysis are believable, trustworthy or authentic" (Kivunja & Kuyini, 2017, p. 34). Participants should find that the results are a true reflection of their contributions (Yilmaz, 2013). The analytic credibility of the research can be ensured by the researcher providing a coherent argument and discussing all relevant results, even if some results were unexpected (Nowell et al., 2017). The credibility strategies, namely peer debriefing, data triangulation, member checks, negative case analysis, and purposive sampling used in this study are elaborated on below:

  - Peer debriefing: feedback was sought from the research supervisors to test insights based on the analysis of the data. The findings were presented to a few peers. Their feedback assisted in improving the quality of the research. Additionally, peer perceptions were sought when developing the conclusion of the study.

  - Data triangulation was used by incorporating different research instruments to capture multiple perspectives (Morrow, 2005). This strategy reduced bias, enabling the researcher to cross-examine the integrity of responses. Additionally, individual viewpoints were verified against others, thus allowing the researcher to construct a rich picture of attitudes and behaviours from a range of different people (Fossey et al., 2002).

  - Member checks were used to include the voices of respondents in the analysis and interpretation of the data collected to eliminate researcher bias (Thomas, 2010).

- Negative Case Analysis refers to the researcher reporting on data that "contradicts the researcher's expectations" (Anney, 2014, p. 277).

- Negative case analysis was used to improve the rigour of the study by providing plausible alternative explanations for any contradictions.

- Purposive sampling was used to focus on participants who are knowledgeable of the issue under investigation, thus ensuring more in-depth findings (Palinkas et al., 2015; Teddlie & Yu, 2007).

➢ Transferability: Kivunja and Kuyini (2017) recommend that the researcher provides sufficient detail about the context of the study and their findings, so that others may relate the findings to their specific contexts. Accordingly, transferability was facilitated by providing a thick description of the context within which the study was carried out and through the use of purposeful sampling. Information on the demographics of participants, the data collection methods used, the number and duration of data collection sessions, and the time period over which data was collected were recorded to allow other researchers to assess the extent to which the findings may hold true in other settings.

➢ Dependability ensures that the processes used to derive the findings are made explicit. It is important that the process is repeatable and consistent across "time, researchers and analysis techniques" (Morrow, 2005, p. 252). Saunders et al. (2019) argue that, when using an interpretivist paradigm, the focus of the research will most likely change as the research progresses. Ensuring dependability in this situation requires that the researcher records all changes so that a dependable account of the research focus is provided. Accordingly, the research design and its implementation was reported on, methods of data collection and analysis were meticulously explained, and analytic memos were created in Atlas.ti to record the codes, categories, and themes (Morrow, 2005; Saunders et al., 2019).

➢ Confirmability requires an acknowledgement that research is never truly objective. The integrity of the findings lie in the data and should represent the "situation being researched" (Morrow, 2005, p. 252). Confirmability was addressed by triangulation to ensure that the findings represent participants' experiences and ideas rather than those of the researcher. A diagrammatic audit trail was presented to trace the course of the research (Shenton, 2004; Anney, 2014).

- Authenticity was ensured by including a range of voices, together with dissenting views, in participants' own words to further explain the researcher's interpretations (Fossey et al., 2002).

- Adequacy: the researcher must collate the data, analysis, and findings in such a way that the reader is able to validate the adequacy of the findings (Nowell et al., 2017). All raw data were saved on a password-protected machine in suitably named folders. The date on which the data was collected was recorded to create an audit trail and to confirm the data analysis and interpretations. Referential adequacy was tested by reviewing the raw data and comparing it to the developed themes to ensure that all conclusions were corroborated by the data (Nowell et al., 2017).

## 4.5. Ethical Clearance

Permission was sought and obtained from the IEB to conduct the research with regional and national moderators from schools affiliated to the IEB. Permission was sought and obtained from the executive heads of the school at which the prototype was evaluated, and the school and assessment body where the UX evaluation framework was evaluated. Ethical clearance to conduct the study was obtained from the School of Computing at UNISA (see **Appendix H**).

## 4.6. Conclusion

This chapter provided an overview of the research methodology followed in this study. The chapter began with an overview of the different research paradigms and a comparison of their ontologies, epistemologies, axiologies, and methodologies. This overview was followed by an explanation of interpretivism and pragmatism and their applicability to this study. A discussion of the research design was followed by an explanation of the research method followed. The latter detailed the rationale for the choice of questionnaire and for the detailed phases that would be followed in data collection and analysis. The discussion of the practical and theoretical contributions preceded a description of the process followed to obtain ethical clearance. The following chapter outlines the results and findings of the PD workshops.

# Chapter 5: Qualitative Results

## 5.1. Introduction

Chapter Four outlined the research paradigms, research design, and research methodology employed in this study. This chapter discusses the qualitative results of the participatory design workshops. This chapter is positioned within the design cycle of the DSR process. Users are positioned within the building component of the PADRE approach. **Section 5.2** presents a descriptive analysis of the two participatory design workshops that were conducted. **Section 5.3** presents an analysis of the qualitative results. **Section 5.4** presents a discussion of the findings based on the qualitative analysis of the results from the PD workshops. A comparison of the criteria for an eModeration system that were extracted from the literature and the criteria obtained from the PD workshops is tabulated in **Table 5-7**. **Section 5.5** concludes this chapter.

## 5.2. Descriptive analysis

Participatory Design workshops focused on two specific aspects to answer the research questions. The first workshop focused on extracting the functional requirements for an eModeration system. The second workshop focused on extracting design ideas to enhance the user experience of the eModeration system. The structure of these workshops is explained below.

- Workshop One:

  - Activity One: participants individually completed a user feedback table (see **Appendix B a)**). Individual participant responses were grouped into themes. The themes were ranked (see **Appendix B c)**) from the most important to the least important to illustrate what the user needs from an eModeration system.

  - Activity Two: participants worked in groups to generate ideas for the design of an eModeration system. Groups completed idea webs (see **Appendix B b)**) identifying stakeholders, the requirements of an eModeration system, the constraints or challenges to the development of an eModeration system, and any questions that would need to be borne in mind when designing an eModeration system.

➢ Workshop Two:

During Workshop Two, participants completed five activities as detailed below.

- Activity One: each group designed different screens for an eModeration system.
- Activity Two: design ideas from activity one were presented to other groups.
- Activity Three: pink, green, and blue sticky notes were used to indicate “Ideas I like”, “Question that I have”, and “Suggestions for Improvement”, respectively, on the design ideas posters.
- Activity Four: all participants collaboratively created a design for an eModeration system.
- Activity Five: participants were each allocated a total amount of R200.00 and encouraged to indicate the value they placed on each design idea.

The following sections discuss the collective results from the activities completed during both workshops, beginning with the responses to the user feedback forms, the ranked themes, and the brainstorming session that resulted in the completed idea web.

## 5.3. Analysis of qualitative results

The analysis of the results was conducted using a Thematic Analysis (TA) framework. **Section 5.3.1** provides an overview of TA and a detailed explanation of how TA was used in this study. In **Sections 5.3.2** to **5.3.4**, the identified themes are used to discuss the results, based on the research questions posed in Chapter One (see **Section 1.4**).

### 5.3.1. Thematic Analysis

Thematic analysis (TA) is a method used to identify, analyse, and report patterns or themes within data (Braun & Clarke, 2020). Themes are identified by searching across a data set to find repeated patterns of meaning. These themes allow the researcher to address the research by organising and describing the data set in rich detail (Nowell et al., 2017). Braun and Clarke (2006) and Maguire and Delahunt (2017, p. 3353) concur that a good thematic analysis does not merely summarize the data, but “interprets and makes sense of it”. Additionally, Braun and Clarke (2006) assert that TA allows the researcher to interpret aspects of the research topic that stretch beyond the semantic content of the data.

TA is not tied to any specific epistemological or theoretical perspective (Clarke & Braun, 2013; Maguire & Delahunt, 2017). Due to its flexibility, TA has been used in diverse fields ranging from psychology, to health services, tourism, and education (Maguire & Delahunt, 2017; Lester et al., 2020). Given the diversity of work in learning and teaching, this flexibility is significantly advantageous in the learning and teaching environment. Braun and Clarke (2006) and Nowell et al. (2017) list TA’s facility to summarize the essential features of a large data set, its flexibility, the capability of generating unanticipated insights and the usefulness of working within a participatory research methodology amongst the many advantages of TA. TA was chosen in this study due to its usefulness in summarizing key features and generating insights, and for its usefulness when participants are collaborators in a participatory design methodology. TA is particularly pertinent to this study, as open-ended responses from teachers and moderators can explore the moderation context at a deeper level, which, according to Castleberry and Nolen (2018) quantitative analysis lacks.

Braun and Clarke's (2006) framework is “arguably the most influential approach”, because it offers a clear, usable framework for doing thematic analysis (Maguire and Delahunt, 2017, p. 3353). Accordingly, the semantic content of the data was investigated using the six phases of TA as postulated by Braun and Clarke (2006), namely,

1. Familiarizing yourself with your data;
2. Generating initial codes;
3. Searching for themes;
4. Reviewing themes;
5. Defining and naming themes; and
6. Producing the report.

Structuring qualitative data analysis into phases creates a systematic process for the researcher to conduct the analysis in a transparent way (Lester et al., 2020). Additionally, an inductive approach (see **Figure 5-5**) of using the actual data in developing the structure of the analysis (Burnard et al., 2008) was used to code the data in this study. Medelyan (2021) cautions that, when using pre-existing coding frames, bias is introduced, and the researcher may miss naturally emerging themes from participant responses. Accordingly, an open coding approach, as recommended by Maguire and Delahunt (2017), was used to iteratively develop and modify the codes during the coding process. The detailed activities that were followed in each phase are elaborated on in the following sections.

**Phase One: Familiarising yourself with your data**

Braun and Clarke (2006, p. 16) maintain that it is vital to become familiar with the "depth and breadth of the content". Becoming truly immersed involves actively reading and re-reading the data to search for meanings and patterns (Belotto, 2018; Castleberry & Nolen, 2018; Nowell et al., 2017).

Compiling data into a useable form is the first step in finding meaningful answers to the research questions (Castleberry & Nolen, 2018). During phase one, the information provided by participants was transcribed into a spreadsheet consisting of four separate sheets based on the activities that were followed during the PD workshops.

- Sheet one captured individual responses to the user feedback table (see **Figure 5-1**, responses from two groups are shown). This information was categorized into the groups that participants worked in and structured into separate columns for each participant of each group. In this way, information was laid side by side so that it was easier to view all identified stakeholder needs and determine the commonalities within and amongst each group.

| Question Number | Question | GROUP 1 Responses | | | | GROUP 2 Responses | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Participant A1 (SG) | Participant B1 (BD) | Participant C1 (RN) | Participant D1 (AP) | Participant A2 (DC) | Participant B2(NS) | Participant C2 (RM) | Participant D2 (CE) |
| 1 | Why would you use an eModeration system? | to facilitate regional and national PAT and SBA moderation. | Collective organization of data.<br>Easy, quick referencing scalability | To moderate either regional or national moderations.<br>To ease the administrative pressures that comes with moderation | It makes it easy to get submissions.<br>Things are available in one place. | Regional Moderation.<br>Internal Moderation. | I would use it tracking purposes.<br>also because of convenience.<br>save on costs.<br>Instant feedback.<br>Ease of communication | To track changes.<br>Add comments.<br>Instantaneous feedback | To keep track of moderation documents.<br>To keep track of only electronic documents.<br>To use to send physical feedback.<br>Instant feedback |
| 2 | What system(s) do you currently use? | One Drive<br>IEB Postbox f<br>reporting<br>Vanitha Rajamany:<br>RQ1 | or and<br>ox | A combination of electronic cloud storage and physical hard copy portfolio.<br>Some make use of google drive shared | Google Drive.<br>One Drive. | Manual/Paper<br>Online- Google<br>annotate pdf<br>Vanitha Rajamany:<br>• RQ1 | e. | Manual-paper based.<br>Moderation and e-moderation (email, google drive, one drive) | Office 365, One Drive, Email, MS Teams, Word, Excel.<br>IEB post box, word to pdf |
| 3 | What do you like about your current moderation systems or processes? | Easy for teachers to access via a link to One Drive. | Easy fill in<br>quick<br>flexible | There is f<br>overall e<br>to send s<br>makes th<br>of portfol<br>need to s<br>copies via courier saving costs and time.<br>Fixing mistakes is easier as files/portfolios are<br>Vanitha Rajamany:<br>• RQ2 | lity to<br>ted links.<br>ase of | Sharing documents online means that document original is edited | As an IT teacher, we have to submit grade 12 PAT's for moderation, using e-moderation, saves me from printing loads of pages, then getting files from the regional moderator, also saves the trees from printing so many pages, students PATS don't get lost. | Original documents- and moderation changes and comments.<br>Manual system-comments and changes made on QP.<br>E-system-changes are tracked and comments are added | No need to print documents.<br>Can easily share a one-drive folder which I have instant access to see what is in One folder.<br>Can easily copy folder staructures.<br>Can share and unshare folders<br>Office 365 apps are easy to work with and not riddled with bugs. |

**Figure 5-1: Data obtained from user interview forms**

- Sheet two included information that was grouped together from individual participant responses to the user feedback table (see **Figure 5-2**). Each group ranked the recurrent themes within their group. This data was captured in the exact format that participants used.

| | GROUP 1 | | GROUP 2 | | GROUP 3 | | GROUP 4 | |
|---|---|---|---|---|---|---|---|---|
| | Themes | Ranked Themes | Themes | Ranked Themes | Themes | Ranked Themes | Themes | Ranked Themes |
| 1 | Organizational ease, administrative ease, National and Regional Moderation | Organization | Audit trail | Security | Process is simpler, sharing is easier. | | Versioning+reason for change | Common doc with versioning+ tracking |
| 2 | Scalable | Ease of Use | Convenient - travel, printing, time of day | Audit Trail | Cloud storage, shared folders, tracking changes - backing up with emails, WhatsApp | | Development process | Automated linking |
| 3 | OneDrive, Google Drive, Postbox (IEB) | Flexibility | Ease of communication and instant feedback | Moderation progress for the moderator and teacher | Easy to share, convenient, all in one place. | | Common document with all development+reasons. Automated linking - memo+question paper+analysis grid to SAGs+frequency from previous years→level. Running totals. | PD - positive feedback - rubric |
| 4 | Easy access, flexibility in uploading and editing or correcting submissions. | Communication | Pre-built templates e.g. analysis grid, documents and appendices already loaded. | Analysis and report writing - pre-built templates for docs e.g. Analysis grids etc. | no human interaction→social aspect. | | PD - positive feedback - rubric. | |

**Figure 5-2: Segment of data illustrating participant identified themes**

- Sheet three of the spreadsheet (see **Figure 5-3**) contained a transcript of the data from each group's idea webs. The data was captured using the concepts provided to participants, that is, stakeholders, requirements, constraint/challenges, important features, and questions we have.

| | GROUP 1 | GROUP 2 | GROUP 3 | GROUP 4 |
|---|---|---|---|---|
| Stakeholders | IEB/UMALUSI | Assessment body e.g. IEB, tertiary, DBE system<br>Verification body e.g. UMALUSI | | |
| Requirements | Good design<br>Minimal updates<br>Robust hardware specifications<br>Functional help / FAQs<br>Security<br>Structured file management system | Cost effective<br>Any type of moderation process e.g SBA question paper must work for ANY subject<br>User friendly & ease of use<br>Intuitive design<br>Security<br>Audit trail<br>Platform independent. | Intuitive interface<br>Internet connectivity<br>Security<br>Digitization process - upload to the system<br>Totalling and summarizing | Bandwidth<br>Authentication multiple users<br>Security<br>21 inch screen or multiple screens |
| Constraints / Challenges | Bandwidth<br>POPIA<br>Technical expertise<br>user buy-in will be difficult<br>Difficulty to have it work on multiple | Load shedding<br>Internet access & bandwidth<br>Types of hardware | Load shedding<br>Poor connectivity<br>Access to devices (smart printer connectivity) | Security<br>Screen size / keyboard<br>Load shedding<br>Bandwidth<br>Teachers' digital skills |
| Important features | Mobile application easy to scan and be alerted<br>An easy integration to clouds<br>Good security (2 factor authentication)<br>Platform independent. | Checklist<br>Moderation progress<br>Voice notes<br>Instant feedback<br>Report generation | Live video chat<br>Notifications<br>Convert between formats<br>Intergration with cloud storage (drive) | Calendar+notifications<br>Tracking deadlines<br>Versioning linked to users<br>Split screen - see question+memo+analysis grid per question - frequency across previous<br>Running totals at the top - qp total, memo total;<br>Taxonomy LOs split<br>Granularity - level 1 will the paper work; mark allocation; level 2 - grammar.<br>Duplicate questions, duplicate answers<br>Questions not asked, content per topic per grade.<br>Layout standards e.g. Appendix, Tracetables |
| Questions we have | What will it cost? (development, end user, management)<br>Who manages the username and logins? (external?, school?)<br>What is the end result?<br>Should it be compulsory to use? | Is there already an existing system?<br>How much will it cost each stakeholder? In product & training?<br>How much beta testing will there be, before it is deployed? | How many years of history will the system keep?<br>Is It free to use?<br>Who develops it? | OCR Maths, Geography |

**Figure 5-3: Data captured in Idea Webs**

- Sheet four of the spreadsheet captured comments made by other teams on the initial screen designs (see **Figure 5-4**). The comments were categorized as "Ideas I Like" (pink sticky notes), "Questions I have" (green sticky notes), and "Suggestions for Improvement" (blue sticky notes).

The data was read several times during the process of transcribing, thus ensuring a greater understanding of the data collected. A note of aspects relevant to each research question (see **Figure 5-1**) was made to provide a "context to create categories of codes" (Belotto, 2018, p. 2625) related to the research questions, minimize the number of codes, and gain an overall sense of the data captured, thus allowing for the formation of ideas and the identification of patterns in the data, as recommended by Braun and Clarke (2006).

| | GROUP 1 | GROUP 2 | GROUP 3 | GROUP 4 |
|---|---|---|---|---|
| Ideas I Like | Calendar<br>Week ahead<br>Templates<br>Chats<br>Names and faces. One stop comments<br>Final hand in<br>Structure<br>FAQ<br>Cluster based<br>Comments on tasks | History of moderation<br>Customise notifications<br>Proof of moderation - feedback<br>Choosing moderators<br>To do list - deadlines<br>Edit while on system<br>Direct contact with moderator<br>Live chat<br>Scheduling meetings<br>Resources<br>speech to text+voice notes<br>database of comments<br>multiple users<br>notifications<br>generating reports<br>comments<br>multiple subject integration<br>cluster trends | History of proof of moderation (x3)<br>Evidence moderation<br>Being able to easily chat with moderator (x6) or leave questions; scheduled meetings/ live chat; direct contact to moderator; teacher Moderator integration; responding/comment; voice notes<br>Choose a relevant moderator<br>Check list (x2)<br>Customise notifications (x5): notification settings; notification/emails; notifications→to phone<br>Online editing (x2); edit while on system;<br>Resources for papers (x2);<br>Resources/stream<br>Dashboard<br>Calendar<br>To do list and deadlines | FAQ<br>Time line<br>Automatic updates<br>OCR<br>Templates(x3)<br>Progress of changes in real time (x2)<br>Moderation paper integration<br>Tracking changes in real time<br>Automation of analysis grids |
| Questions I have | | How would security be adhered to for so many users?<br>Would UMALUSI be able to see all schools all assessments?<br>How to control? | | How will this (Calendar and notifications) work for multiple items? |
| Suggestions for Improvement | Automatic Feedback<br>More user types to be included | Should give access to everyone and restrict certain info/stages or through access controls. | | Progress bar to show tracking |

**Figure 5-4: Design Comments**

Phase one is acknowledged as an interpretative act that provides the foundation for the rest of the analysis (Braun & Clarke, 2006). The captured data was verified against the original information to ensure that the transcript contained accurate information, so that meaningful knowledge could be obtained.

**Phase 2: generating initial codes**

In Phase two of TA, data is organized in a meaningful and systematic way (Maguire & Delahunt, 2017). Phase two involves generating an initial list of codes about what constitutes the data and what is interesting about them (Braun & Clarke, 2006). Prior to explaining the process of generating the initial codes, it is first necessary to explain what codes are and what their purpose is when analysing data. The following section explains what codes are and provides a description of the process followed in generating these codes.

Codes refer to the basic elements of the raw data that captures the essence of the data (Saldaña, 2009). A code is usually a single word or phrase that enables the researcher to identify interesting characteristics of the data that can be assessed in a meaningful way (Braun & Clarke, 2006; Saldaña, 2009). The coding process occurs between data collection and data analysis (Saldaña,

2009) and serves to reduce data into smaller, more meaningful segments so that the researcher can focus on specific characteristics of the data (Maguire & Delahunt, 2017; Nowell et al., 2017).

Castleberry and Nolen (2018) and Medelyan (2021) concur that coding allows the researcher to retrieve and categorize similar data, interpret the data, and draw conclusions from the results (Charmaz, 2006; Saldaña, 2009). Coding is described as generating “the bones” of the analysis, which is assembled thereafter during theoretical integration into a “working skeleton” (Charmaz, 2006, p.45). Good codes capture the “qualitative richness” of the phenomena being researched (Nowell et al., 2017, p.6).

One of the first steps in qualitative data analysis is preparing and organizing the data for TA (Lester et al., 2020). ATLAS.ti® is a widely used tool, streamlining the qualitative data analysis process to enable a deeper analysis of the data (Castleberry & Nolen, 2018). To facilitate the coding process and provide a visual representation of the codes, all audio and video recorded activities of workshop participants, images of screen designs, and the spreadsheet data were transferred to ATLAS.ti® Version 9. Each sheet of the spreadsheet was saved into a different text document.

The data was stored in a structured way in one location using a consistent naming convention for each file, for example, Group 1 Design Discussion Recording. In addition to providing a structured file organization system, the process of transferring data to ATLAS.ti® enabled me to become more familiar with the data collected, in line with Lester et al.'s (2020, p. 99) assessment that such familiarity “deepens a researcher’s understanding of the participants’ perspectives and supports them in understanding the data set in a way that accelerates analysis later on”.

During open coding, the inductive process of generating codes arises directly from participant responses (Medelyan, 2021) (see **Figure 5-5**). The inductive coding process followed in this study is outlined in the following sections.

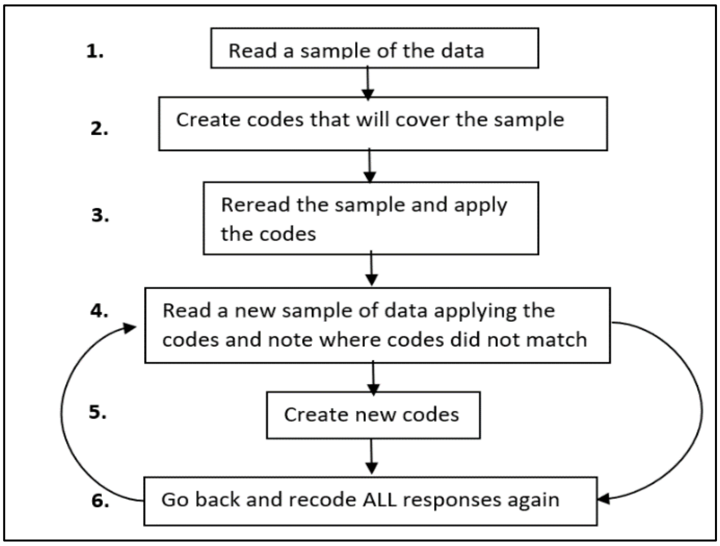



**Figure 5-5: Inductive coding**

In line with Saldaña's (2009) recommendation that it may be beneficial to first code one participant's data and then move to the second participant's data, the data from each participant of only the first two groups was initially read and reread to create initial codes (see steps one to three in **Figure 5-5**), as depicted in **Table 5-1**. Thereafter, responses to each question were worked through systematically across the entire data set (see steps four to six in **Figure 5-5**). Full attention was given to the responses to each question by all participants across all groups to identify any interesting aspects in the data items that could form the basis of repeated patterns across the data set. Codes were used to identify and label all words and sentences that conveyed similar meanings (Belotto, 2018). For instance, "track changes", "tracking", and "track documents" were coded as Tracking. A sample of the quotations and the initial coding derived from similar words and phrases is depicted in **Table 5-1** to indicate which groupings of quotations contributed to a specific code.

**Table 5-1: Initial codes**

| **Quotation** | **Initial coding** |
|---|---|
| Easy, easy to access | Ease of use |
| One location, convenience, quick reference | Convenience |
| Facilitate moderation, organization of data | Facilitation |
| Tracking, track changes, track documents | Tracking<br>Audit trail |
| Cost-saving, transport costs, printing costs | Costs |

| Quotation | Initial coding |
|---|---|
| Easy, easy to access | Ease of use |
| One location, convenience, quick reference | Convenience |
| Instant feedback | Instant feedback |
| Ease of communication | Communication |

Care was taken to code and collate actual data extracts within each code. Selections of text within each data item were coded in ATLAS.ti® by tagging and naming them (Braun and Clarke, 2006). Items were coded for as many potential themes as possible, while retaining the context.

Steps four to six were iteratively executed to create code groups (see **Figure 5-6**). For instance, when responding to the question of why an eModeration system would be used, participants mentioned saving costs with the amount of paper used and reducing transport and printing costs. A code group was created for cost savings to group these aspects together. Furthermore, since these responses were similar and were all examples of the benefits of an eModeration system, cost savings were prefixed by the word Benefits. All mention of saving costs were grouped into this category so that the data could be filtered for the benefits of adopting an eModeration system.

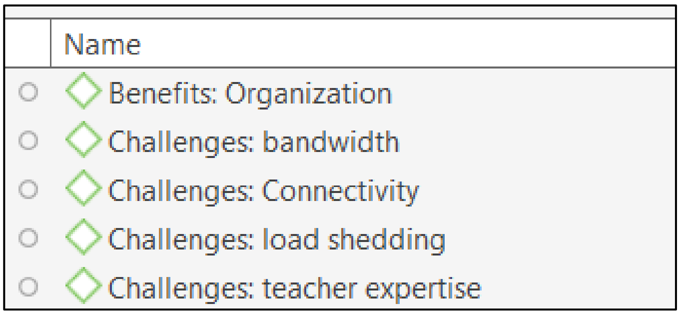



**Figure 5-6: Coding groups in ATLAS.ti®**

While coding, the data was repeatedly read to ensure that words or phrases were being correctly coded and categorized. Noting the similarities and differences, further categories were created to group similar items (see **Table 5-2**).

**Table 5-2: Initial Categories**

| Category | Code | Similar item |
|---|---|---|
| Challenges of eModeration | Bandwidth | |
| | Connectivity | |
| | Load shedding | |
| | Teacher experience | Technical skills |
| Benefits: Cost saving | Paper | |
| | Printing | |
| | Transport | |
| Current systems | Electronic | Dropbox, Teams, Google drive, IEB Post Box, Office documents, email, One Drive |
| | Manual | |
| | Combination | |
| Popular design ideas | Voice notes | |
| | FAQ | |
| | Chat functionality | Notifications |
| | Customized notifications | |
| Requirements | History of moderation | |
| | Audit trail | |

Aspects that did not clearly fit into a particular code were retained, even if they were not consistent with the central narrative in the analysis as advocated by Braun and Clarke (2006). Saldaña (2009) and Nowell et al. (2017) caution that deletion of as yet unknown units of data that deviate from the central narrative could result in losing elements that could be used to weave everything together. For instance, in this study, one group placed more emphasis on creating an assessment rather than on the moderation of assessments, which is the focus of this study. These accounts were included in the original coding using the code "Creating Assessments", and were retained as part of a miscellaneous category of codes as depicted in **Table 5-3,** which depicts a segment of the identified codes.

**Table 5-3: Identified themes**

| Theme | Quotation | Code |
|---|---|---|
| Challenges of eModeration | We sometimes have to have documents scanned through. | Scanning |
| | Formatting differences between school; Different versions of documents (drive). | Uniformity |
| | Bandwidth: What happens if there is no electricity or Internet access? What process will still be in place to facilitate eModeration? Connectivity; Load shedding; It is affected by load shedding - needs stable internet connectivity; Links expire too quickly. | Connectivity |

| Theme | Quotation | Code |
|---|---|---|
| | Time consuming (administration).<br>Have to set up on One Drive folders for school have to restrict access to folder.<br>Have to email link; Then have to post reports on IEB Postbox.<br>The deadlines are not always possible or teachers do not check the deadlines. | Time consuming |
| | Takes the human collaboration aspect, e.g., live paper setting and moderation. | No human contact |
| | Technical skills; teacher experience. | Skills |
| Functional requirements | Ensure security; Some other people could see my work or students work; Login with secure email and password. Good security (2 factor authentication). | Security |
| | Stage by stage analysis of content/completion; Show development of moderation process. | Progress bar |
| | Work on latest version-so no version errors. | Versioning |
| | Ability to have predefined comments; Database of comments which are customisable. The ability to easily comment; Maybe by saving a voice note or mark easily. | Pre-defined comments |
| | A centralised location like Microsoft Teams for live collaboration and chat; Perhaps if it is collaborative it would help - maybe work on MS Teams together- moderator and examiner. | Collaboration |
| | A centralised location like Microsoft Teams for live collaboration and chat. | Centralization |
| | Tracked deadlines. | Tracking |
| | Structured system allows for stages in moderation process; Upgrade IEB Postbox to include facilities where teachers can upload SBA and PAT in predefined organized folders. | Organized structure |
| | Notification errors if things are missing, or requirement not met.<br>A notification when things are uploaded, edited and/or deleted. Alert the person uploading the document; A central team with high response times, e.g., upload and receive notification when feedback is ready; Alert teacher if required SBA and PAT requirements are not submitted within the required timeframe. Calendar+ notifications. | Notifications |
| | Intuitive design; Intuitive Interface. | User friendly |
| User experience Requirements | Flexibility in uploading and editing or correcting submissions. | Flexibility |
| Miscellaneous | Assessments. | Creating assessments |

### Phase three: searching for themes

Phase three begins when all data has been initially coded and organised (Braun & Clarke, 2006). Themes are abstract entities that capture something important in relation to the research questions, forming the basis for the interpretative analysis of the data (Braun & Clarke, 2006; Nowell et al., 2017). Phase 3 focuses the analysis at the broader level of themes to represent meanings within the data set (Braun & Clarke, 2006; Castleberry & Nolen, 2018). All relevant, coded data extracts are collated within the identified themes during this phase (Braun & Clarke, 2006).

The codes were analysed to determine how different codes could be combined to form overarching themes and sub-themes using ATLAS.ti®. The possible sub-themes and codes for the overarching theme of Benefits of eModeration are depicted in **Table 5-4**.

**Table 5-4: Possible themes**

| Theme | Sub-theme | Code |
|---|---|---|
| Benefits of eModeration | Cost savings | Cost saving: printing<br>Cost saving: paper<br>Cost saving: transport |
| | Communication | Communication: notifications<br>Communication: voice notes<br>Communication: chat |

Participants were tasked with identifying the requirements of an eModeration system and suggesting features that they would include in an eModeration system. The challenge was to differentiate between these requirements and features. Consistent with literature, a decision was taken to regard requirements as "must haves" (University-of-Colorado, 2021, p. 170) and features as additional functionality that would enhance the user experience. Requirements and features were included as functional requirements and user experience requirements, respectively (see **Table 5-4**).

**Phase 4: reviewing themes**

Phase four involves devising a set of possible themes and refining them. During this phase, themes may need to be broken down into separate themes, and other themes may need to be combined or removed (Braun & Clarke, 2006; Nowell et al., 2017). Data within themes should integrate meaningfully, with clearly identifiable distinctions between themes (Braun & Clarke, 2006). In this study, the collated extracts for each theme were read to determine whether they formed a coherent pattern.

**Phase 5: defining and naming themes**

Phase five involves defining and further refining the themes used for the analysis. Braun and Clarke (2006) caution that themes should not be too diverse or complex. It is essential not to simply paraphrase data extracts, but to identify interesting facts about the data with clearly articulated reasons as to why these facts are of interest (Braun & Clarke, 2006). In this study, the data extracts for each theme were collated and organised into a coherent account consistent with the associated narrative by including the quotation to preserve the context (see **Table 5-4**).

**Phase 6 producing the report**

Phase six involves the final analysis and write-up of the report (Braun & Clarke, 2006; Maguire & Delahunt, 2017). The researcher makes analytical conclusions from the data presented, firstly as codes and thereafter as themes (Castleberry & Nolen, 2018). The aim of the report is to present a compelling argument about the data in relation to the research questions by embedding chosen extracts within an analytic narrative (Braun & Clarke, 2006).

The following discussion is structured around the responses to the activities of Workshop One.

### 5.3.2. Results from group activities: Workshop One

The responses from the user feedback table, the ranked themes, and the brainstorming session provide a basis for the following discussion beginning with a description of teachers' current moderation practices.

#### 5.3.2.1. Current moderation practices

Considering system(s) that teachers and moderators use for moderation, 73% (N = 15) indicated the use of shared folders on Google Drive and / or Google documents, 33% mentioned the use of the IEB Post Box system, whilst others mentioned the use of One Drive, Office documents to track changes and email to communicate with each other. Five participants indicated the use of *"physical hard copy portfolio"* and *"written feedback on printed doc"* in addition to software applications. Four participants indicated the use of MS Teams, and one participant indicated the use of annotation tools using Kami. Participant responses thus indicate a combination of electronic and manual, paper-based moderation processes.

Despite an indication of the use of software applications to conduct moderation processes, participants indicated that there is no standard software application that all moderators utilize, as evidenced by the comment *"Have not used a specific e-moderation app, just MS Word-review and upload to One Drive/Google Drive/Email" (*D3). This finding is consistent with the assertion of Rajamany et al. (2020a) that dedicated software applications to carry out digital moderation are lacking and lends credibility to the statements made by Van Staden et al. (2019) that not much effort has been made to implement available technologies in supporting moderation. These results strengthen the justification for this study, as articulated in **Section 1.3**.

#### 5.3.2.2. Likes, dislikes and challenges

Aspects that participants liked and disliked about their current moderation processes and the challenges identified in the implementation of an eModeration system are summarized in this section. These aspects are grouped and expanded on further in **Section 5.3.2.3**, due to their significance in translating into design and functional requirements of an eModeration system.

Aspects that participants liked about their current moderation processes can be summarized as access to organized, centralized storage; easy access and sharing of files; the ability to track changes; and cost and time savings.

There was not much consensus on the aspects that participants disliked about the moderation process when considering moderation from the different perspectives of a manual process and a digital moderation system. Whilst some participants mentioned the disadvantages of a manual, paper-based moderation process, others mentioned the disadvantages of the digital moderation process, as outlined below:

- The disadvantages of a manual paper-based moderation process included the time frame of the moderation process, especially when having to post paper-based assessments via registered mail, paper-based moderation being regarded as *"bulky"* (A2), and the need to *"scan documents"* (D3).
- Disadvantages of digital moderation included having to create and restrict folders, having to email a link to the teacher, links expiring too quickly, the restricted capacity specifically with

reference to OneDrive, and differing formats of documents amongst different schools. One participant indicated the lack of human collaboration as a disadvantage of using a digital moderation system.

Participants articulated the following as aspects that they generally disliked about the current process: a lack of uniformity in moderation processes arising from not having a dedicated system, a lack of notifications, the need for a stable Internet connection, the effect of load shedding, differing formats of documents, and tracking changes becoming too messy.

All groups considered bandwidth and Internet connectivity as challenges in introducing an eModeration system. Three groups highlighted load shedding, technical expertise, and teacher buy-in as challenges. One group identified access to devices such as a smart printer as a challenge, whilst another group pointed to screen or keyboard size as limiting factors. Additional challenges pertain to the lack of a dedicated eModeration system. These challenges can be summarized as a lack of notifications because current systems are not made specifically for moderation; no set standard for uniformity; and not receiving confirmation of files being uploaded and received.

#### 5.3.2.3. Requirements of an eModeration system

As explicated in **Section 2.5.1.6**, the stance taken in this study was to define requirements as the functional and design expectations of an eModeration system. Accordingly, the responses to questions pertaining to the need for an eModeration system, the improvements and functionality to include, the features of an eModeration system, and the requirements are presented together. The dominant themes pertain to the facilitation of the moderation process, communication, and hardware and system requirements.

##### 5.3.2.3.1. Facilitation of moderation

A key reason identified for using an eModeration system was to facilitate the process of regional and national moderation of student portfolios. Examples of participant responses included: *"it makes it easy to get submissions"* (C1) and *"to simplify the process of portfolio moderation"* (B3). The recurring focus on convenience emphasized the importance of an eModeration system in facilitating moderation processes, thus easing the load on teachers and saving them time. The key themes concerning the facilitation of moderation pertain to tracking, alerts and notifications, cost savings, and file management.

- With respect to tracking, responses highlighted a need to track changes, track the moderation process, and track whether deadlines had been met. Considering tracked changes, the advantages to a digital moderation process included "*Can see time/date + who made changes*" (A4) and that tracking would "*Show development of moderation process*". Tracking the different versions of moderation documents would allow the moderator to "*Work on latest version-so no version errors*" (A4). Concerning deadlines being met, participants mentioned a "*stage by stage analysis*" (B1) of completion of the moderation process and "*Tracked deadlines*" (D1) which would alert teachers and moderators of deadlines not being met. An emphasis on tracking the process demonstrates the need for a system that allows teachers and moderators to ensure that they are working on the most current version that contains an audit trail of the edits made.

- The inclusion of notifications and alerts was the most frequent response to questions pertaining to functionality to include. Notifications were articulated in the context of alerting the moderator and assessment body if deadlines were not met; notifications when documents are uploaded, edited, and/or deleted; and when feedback from the moderation process is ready. Participant A1 indicated the need to "*alert (the) teacher if required SBA and PAT requirements are not submitted within the required timeframe*", while participant A2 indicated that the person uploading the file should be alerted when the file is uploaded.

- Notably, cost-savings was a common response articulated in terms of the benefits arising from a reduction in printing costs, the cost of transport, and saving of paper. Digital moderation eliminates the cost of sending hard copies "*via courier*" (C1), saves the time taken to print "*loads of pages*", and saved paper. Digital moderation of portfolios provides teachers with the added benefit of saving valuable time from having to "*travel to moderation venues set up by assessment bodies*" (C2) to complete the moderation process.
- Considering file management, facilitation of moderation pertains to centralized file storage and the related advantage of file sharing, ease of access, and having an organized file structure.

- With reference to the need for centralization of documents, responses included "*Easy, quick referencing*", "*Things are available in one place*", and that centralization provides a "*Collective organization of data*". Centralized storage enables the synchronization and cross-referencing of moderated documents. This finding confirms the views of Booth and Rennie (2015) and Newhouse and Tarricone (2016) that eModeration ensures that moderated script(s) are electronically available for future reference. Considering file sharing as a result of centralized storage, 46.7% of the participants focused on the advantages of easily sharing and accessing files from a central location, as evidenced by the comment *"can easily share a Onedrive folder which I have instant access to see what is in Onedrive folder*" (D2).
- Considering ease of access and flexibility, participants indicated that accessing files via a link to online storage provided flexibility and made "*the organization of portfolio(s) easier*" (C1).
- Concerning an organized file storage, the dominant theme was to "*Develop an e-portal where papers are uploaded*" (C2) with participant D1 indicating that an "*organizational setup*" needed to be a "*priority*". Participants further elaborated that they would like to have an organized structure with "*pre-defined organized folders*" (A1). Organization was also mentioned in the context of organizing the different stages of the moderation process according to priority levels.

#### 5.3.2.3.2. Communication

Responses around communication were articulated in terms of the ease of communication, instantaneous feedback, and the provisioning of functionality for comments and communication between stakeholders of a digital moderation system. Concerning ease of communication, participants indicated that a digital moderation system facilitated communication as evidenced by D3, commenting that *"Communication is quick and response time even quicker"*. Notably, three of the four participants in group two mentioned the need for instant or *"instantaneous"* feedback as a reason for using an eModeration system. The focus on instantaneous feedback and ease of communication is consistent with previous findings that eModeration provides faster feedback

(Booth & Rennie, 2015; Newhouse & Tarricone, 2016), which resonates with the focus of this study.

Concerning comments and communication, a focal point was a database of customizable, pre-defined comments to enable the moderator to easily comment on assessed documents. Related features indicated by participants in Groups two and three were the ability to leave voice notes and the need for a live collaborative space within which moderators and teachers could chat with each other.

#### 5.3.2.3.3. Hardware and system requirements

*"Robust hardware specifications"* and the need either for a larger screen or multiple screens were identified as requirements. Additionally, Internet connectivity, bandwidth, and platform independence were identified as requirements of an eModeration system. Participants emphasized the need for a stable Internet connection and questioned the effect of load shedding on connectivity. Responses to system requirements centred around the design of the interface, security, and help functionality, as described below.

- For interface design, three of the four groups included user friendliness, ease of use, and intuitive design/interface amongst the required design elements. Participant D1 indicated that it would be *"nice"* to have *"more features"* while ensuring that the system is *"user friendly"*. However, D1 did not elaborate on what additional features would be nice to have. While participant A2 indicated that relevant documents should be available, no clarity was provided as to what documents were referred to. In contrast, participant C2 indicated the need for report writing and analysis features.

- Security was the highest ranked theme by one group, and was identified by all groups on the idea web template. One group also required authentication for multiple users by means of secure email addresses and passwords. Confidentiality of individual school and student work was another important aspect of security.

- Help: Participants highlighted the need for help functionality, mentioning a "*ticket/help system*" (C1), a *"functional help system"*, and *"FAQs"*.

Other features included a mobile application with cloud storage integration, platform independence, a checklist, report generation, format conversions, and a calendar with notifications. Two participants expanded on features for automatic changes to the mark allocation on the memo whenever the mark allocation on the question paper changed, and the self-generation of analysis grids. This study focused on moderation of assessments. Features related to creating an assessment, such as automatic mark allocation changes and self-generation of analysis grids, were not included in the final analysis.

#### 5.3.2.4. Identification of stakeholders

One group identified the assessment body as an additional stakeholder to the teachers, moderators, and subject heads as stakeholders of the system.

### 5.3.3. Design Ideas

Activities one and two of Workshop Two involved the design and presentation of different screens of an eModeration system. All participants added coloured sticky notes to the design ideas presented (see **Section 5.2**) to indicate the ideas they liked. **Table 5-5** depicts the number and percentage of likes for each item.

All groups designed a log in screen requiring a username and password as the first screen. The screens generally took the form of separate dashboards for the moderator and teacher. All groups emphasized the tracking of moderation progress and meeting deadlines by making use of methods such as calendars (Groups 1 and 3), and checklists (Groups 2 and 3). All groups included a view of all required documents for submission to keep teachers informed.

As depicted in **Table 5-5**, a *"week ahead"* feature or a to-do list was identified by one group. Group four provided a slightly different perspective by including a timeline. The calendar functionality included by Group 1 received 20% of the likes, while the calendar functionality provided by Group 3 received 6.7% likes. The most popular design feature was a chat facility with live chat for direct contact between moderator and assessor, receiving 40% of votes.

**Table 5-5: Frequency of Likes**

| | ITEM | NO | % | ITEM | NO | % | ITEM | NO | % | ITEM | NO | % |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Ideas I Like | Calendar | 3 | 20 | Moderation Progress | 1 | 6.7 | History of proof of moderation | 3 | 20 | FAQ | 1 | 6.7 |
| | Week ahead | 1 | 6.7 | Customise notifications | 3 | 20.0 | Live chat with moderator /leave questions | 6 | 40 | Time line | 1 | 6.7 |
| | Templates | 1 | 6.7 | Voice notes | 4 | 26.7 | Comments | 1 | 6.667 | Automatic updates | 2 | 13.3 |
| | Chats | 1 | 6.7 | Proof of moderation - feedback | 1 | 6.7 | Voice notes | 1 | 6.667 | OCR | 1 | 6.7 |
| | Names and faces | 1 | 6.7 | Speech to text | 5 | 33.3 | Choose a relevant moderator | 1 | 6.667 | Templates | 3 | 20.0 |
| | Comments | 2 | 13.3 | Database of comments | 4 | 26.7 | Check list | 2 | 13.33 | Progress of changes in real time | 2 | 13.3 |
| | Final hand in Structure | 1 | 6.7 | Multiple users | 6 | 40.0 | Customise notification/emails; notifications→to phone | 5 | 33.33 | Moderation paper integration | 1 | 6.7 |
| | FAQ | 1 | 6.7 | Generating reports | 3 | 20.0 | Online editing | 2 | 13.33 | Tracking changes in real time | 1 | 6.7 |
| | Cluster based | 1 | 6.7 | Multiple subject integration | 1 | 6.7 | Resources for papers | 2 | 13.33 | Automation of analysis grids | 1 | 6.7 |
| | | | | Cluster trends | 1 | 6.7 | Dashboard | 1 | 6.667 | | | |
| | | | | Feedback | 1 | 6.7 | Calendar | 1 | 6.667 | | | |
| | | | | Checklist | 1 | 6.7 | To do list and deadlines | 1 | 6.667 | | | |
| | | | | Printing | 1 | 6.7 | Teacher moderator integration | 1 | 6.667 | | | |
| | | | | | | | Peer to peer moderation | 1 | 6.667 | | | |

Three groups included the ability to make comments and edit documents online. Group two added a database of comments as a feature, and Group one included a task-specific commenting feature. The database of comments received 26.7% likes.

Notably, Group two was the only group to include multiple subjects and multiple users (other than the teacher and moderator), which received 40% of the likes. Group four included an OCR function for Mathematics and Geography.

### 5.3.4. Final Design Decisions

Participants unanimously agreed that the functionality provided by the eModeration system should be based on the role of the user; for example, the moderator would have different functionality to a teacher. Consequentially, the first screen of the eModeration system enabled the user to log in, with the choice of selecting the role of a teacher or a moderator based on the username. Thus, only functionality pertinent to a role would be displayed.

Participants designed a Dashboard with separate Moderator and Teacher Views. Although the different views are presented in a linear fashion in the following section, the discussion and evolution of the different views were cyclical in nature.

Participants designed a Dashboard presenting a moderator and teacher button after a secure log on. An expand button was included to add to the functionality for teachers who were teaching different subjects. An additional function was to provide a user settings/preferences button so that users could customize the settings according to their preferences.

The moderator view would include a list of the schools to which the moderator had been assigned for the moderation of assessments. The moderator would be able to view a checklist with all uploaded documents for each task of each school. The inclusion of a progress bar would enable the moderator to view schools' submissions. Customized, automatic notifications linked to a checklist and Calendar were included to indicate whether deadlines had been missed or if items were missing.

The moderator screen was customized according to the subject and schools allocated to the specific moderator. The moderator screen included the facility to upload subject-specific documents, templates for the regional moderator to fill in, and functionality to download a report.

The teacher view was designed to include notification icons. Each component would have a different icon based on status. For instance, the icon would indicate that the uploaded document was incomplete. The teacher screen would include pre-populated templates, checklists for the documentation needed by the assessment body, and functionality to print the checklist. Including a icon would enable teachers to view all relevant documents.

Participants proposed the following functionality:

- An assessment tool generator; and
- The inclusion of a cluster leader role.

Participants agreed that an assessment tool generator could be incorporated at a later stage, while the inclusion of a cluster leader role would result in too many people having access to the system, making it difficult to manage. These ideas were not implemented.

Participants agreed that the teacher view needed buttons to upload portfolios, view moderation documents, a checklist, comments, a progress bar, and a chat facility (FAQ or Chat Bot) to assist teachers in uploading assessments where necessary.

The qualitative findings from the PD workshops are presented in the following section.

## 5.4. Qualitative findings from PD workshops

Notably, no new variables were identified for learnability from the PD workshops. This finding is consistent with the participant demographics (see **Table 4-5**). All participants were experienced IT teachers and moderators with more than five years of experience. Although participants had initially raised the issue of "*teachers' digital skills*", "*user buy-in*", and "*technical expertise*" as general constraints of implementing an eModeration system, it is evident that this group of users did not classify themselves as lacking technical expertise, as these challenges were not raised again.

In line with the view expressed by Dresch et al. (2015) of the need for DSR to add value to existing theoretical knowledge and improve practical situations in organizations, criteria identified from the PD workshops were mapped to the usability constructs identified in the theoretical framework (see **Figure 3-14**) to produce new criteria for inclusion in an eModeration evaluation framework. The criteria from the PD workshops are depicted in **Table 5-6**.

**Table 5-6: Criteria elicited from PD**

| **Description** | | | |
|---|---|---|---|
| **COMPONENT** | **CONSTRUCT** | **CRITERIA** | |
| SYSTEM REQUIREMENTS | System quality | Audit trail | Multi-user authentication |
| | | Annotation tools | Multi-user technology |
| | | Calendar | Notifications |
| | | Checklist | Reliability |
| | | Choose moderator | Response time |
| | | Compatibility | Robust hardware specifications |
| | | Cross platform | Security |
| | | Customizable comments | Synchronization |
| | | Dependability | Tracking changes |
| | | External communication | Tracking deadlines |
| | | Flexibility | Tracking documents |
| | | Infrastructure and Resources | Voice-over button |
| | | Internet connectivity | Web-based |
| | Information quality | Accuracy | Progress Bar |
| | | Centralized data storage | Reminders of deadlines |
| | | Compatibility | Reporting |
| | | Data Currency | Security of information |
| | | File format | Timeliness |
| | | Instant feedback | Versioning |

| Description | | | |
|---|---|---|---|
| COMPONENT | CONSTRUCT | CRITERIA | |
| | Service quality | FAQ | Technical support |
| | | Functional help | Ticketing help system |
| | | Quick response | |
| TASK | Efficiency | Built-in templates | Online editing |
| | | Cost saving | Reduced printing |
| | | Database of comments | Time saving |
| | | Environmentally friendly | Live video chat |
| | | Integration with cloud storage | Voice notes |
| | Effectiveness | Automatic updates | Organized file structure |
| | | Collaboration | Shared folders |
| | Satisfaction | Ease of use | Task performance |
| | | Satisfaction with specific functions, e.g., sharing | User friendly |
| | Flexibility | Platform independent | Multiple roles |
| | | Multiple subject integration | |
| | Learnability | N/A | |
| USER | Hedonic qualities | Customized notifications | Customized settings/user preferences |
| | | Intuitive interface | |

Based on their specific requirements, PD workshop participants included criteria that were not evident in the literature reviewed (see **Table 5-6**). Additional criteria included in the system quality dimension were the facility for tracking documents, changes, and deadlines. Further, criteria not previously identified from literature were included as part of the service quality, user experience and flexibility constructs (indicated in italics in **Table 5-7**). Participants emphasized the help functionality included in the system, the need for a quick response time, customized notifications, platform independence, and the need for multiple subject integration.

It is significant that these criteria contribute to aspects that domain experts regard as integral to an eModeration system, thus answering Research Question three and adding value to the existing body of knowledge. The specific user experience criteria that add to the net benefits of the use of an eModeration system were identified as customized notifications, an intuitive interface, and the facility for a live video chat with the moderator (see **Table 5-7**).

During the group design discussions, two groups indicated a need for the moderator to "*comment on the document*"; however, participants did not elaborate on this functionality. While participants discussed functionality to edit documents online and addition of an MS Word plugin to enable them to do so, the inclusion of an annotation tool functionality in the final design was omitted from all discussions. Extant literature provides a convincing argument for the inclusion of annotation tools, resulting in annotation tools being previously included as a user requirement for an eModeration system (see **Figure 5-2**).

Various statements made by participants indicate the significance of the need to "*track changes*", "*track documents*", "*track deadlines*", and to "*generate a history of the proof of moderation*". These were coded as *tracking* and were included as criteria in the Systems Quality construct identified in the theoretical framework (see **Figure 3-14**). As depicted in **Table 5-7**, these are context-specific criteria that stakeholders believe should be incorporated in a dedicated eModeration system.

**Table 5-7: Comparison pre and post PD Criteria**

| **COMPARISON OF PRE AND POST PD CRITERIA** | | | | |
|---|---|---|---|---|
| **Description** | | | **Identified from literature review** | **Identified from PD workshops** |
| **COMPONENT** | **CONSTRUCT** | **CRITERIA** | | |
| System Requirements | System quality | Audit trail | ✔ | ✔ |
| | | Availability | ✔ | |
| | | Calendar | ✔ | ✔ |
| | | Capability | ✔ | |
| | | Checklist | ✔ | ✔ |
| | | Choose moderator | ✔ | ✔ |
| | | Compatibility | ✔ | ✔ |
| | | Complexity | ✔ | |
| | | Cross platform | ✔ | ✔ |
| | | Dependability | ✔ | ✔ |
| | | External communication | ✔ | ✔ |
| | | Flexibility | ✔ | ✔ |
| | | Infrastructure and resources | ✔ | ✔ |
| | | Multi-user authentication | ✔ | ✔ |
| | | Multi-user technology | ✔ | ✔ |
| | | ***Multiple screens*** | | ✔ |
| | | Notifications | ✔ | ✔ |
| | | ***OCR*** | | ✔ |
| | | Organized file structure | ✔ | ✔ |
| | | Reliability | ✔ | ✔ |
| | | Response time | ✔ | ✔ |

| COMPARISON OF PRE AND POST PD CRITERIA | | | | |
|---|---|---|---|---|
| **Description** | | | **Identified from literature review** | **Identified from PD workshops** |
| **COMPONENT** | **CONSTRUCT** | **CRITERIA** | | |
| | | Robust hardware specifications | ✔ | ✔ |
| | | Security | ✔ | ✔ |
| | | Synchronization | ✔ | ✔ |
| | | Tracking changes | ✔ | ✔ |
| | | Web-based | ✔ | ✔ |
| | Information quality | Accuracy | ✔ | ✔ |
| | | ***Centralized data storage*** | | ✔ |
| | | Completeness | ✔ | |
| | | Data currency | ✔ | ✔ |
| | | Format | ✔ | ✔ |
| | | Instant feedback | ✔ | ✔ |
| | | Legibility | ✔ | |
| | | Output quality | ✔ | |
| | | Progress bar | ✔ | ✔ |
| | | Reminders of deadlines | ✔ | ✔ |
| | | Reporting | ✔ | ✔ |
| | | Security of information | ✔ | ✔ |
| | | Timeliness | ✔ | ✔ |
| | | ***Versioning*** | | ✔ |
| | Service quality | ***FAQ*** | | ✔ |
| | | ***Functional help*** | | ✔ |
| | | Technical support | ✔ | ✔ |
| | | ***Ticketing help system*** | | ✔ |
| TASK REQUIREMENTS | Efficiency | Annotation tools | ✔ | ✔ |
| | | Built-in templates | ✔ | ✔ |
| | | Database of comments | ✔ | ✔ |
| | | Cost saving | ✔ | ✔ |
| | | ***Integration with cloud storage*** | | ✔ |
| | | ***Online editing*** | | ✔ |
| | | Reduced printing | ✔ | ✔ |
| | | Time saving | ✔ | ✔ |
| | | ***Tracking deadlines*** | | ✔ |
| | Effectiveness | Availability | ✔ | |
| | | Automatic updates | ✔ | ✔ |
| | | Capability | ✔ | |
| | | ***Collaboration*** | | ✔ |
| | | Dependability | ✔ | ✔ |
| | | Progress bar | ✔ | ✔ |
| | | Shared folders | ✔ | ✔ |
| | | ***Tracking documents*** | | ✔ |
| | | Voice-over button | ✔ | ✔ |
| | Satisfaction | Usefulness | ✔ | |
| | | Ease of use | ✔ | ✔ |
| | | Satisfaction with specific functions, e.g., sharing | ✔ | ✔ |
| | | Task performance | ✔ | ✔ |
| | | ***User friendly*** | | ✔ |
| | Flexibility | ***Platform independent*** | | ✔ |

| COMPARISON OF PRE AND POST PD CRITERIA | | | | |
|---|---|---|---|---|
| **Description** | | | **Identified from literature review** | **Identified from PD workshops** |
| **COMPONENT** | **CONSTRUCT** | **CRITERIA** | | |
| | | ***Multiple roles*** | | ✔ |
| | | ***Multiple subject integration*** | | ✔ |
| | Learnability | Digital literacy | ✔ | ✔ |
| | | Self-efficacy | ✔ | |
| | | Training and experience | ✔ | |
| USER REQUIREMENTS | Hedonic qualities | Aesthetics | ✔ | |
| | | Customized notifications | ✔ | ✔ |
| | | ***Intuitive interface*** | | ✔ |
| | | ***Customized settings*** | | ✔ |
| | | ***Live video chat*** | | ✔ |

## 5.5. Conclusion

This chapter reported on the analysis of the data collected during two PD workshops. The chapter objectives were fulfilled by firstly identifying the functional requirements for an eModeration system based on participant responses to the user feedback table. Secondly, the UX criteria to be included in the design of an eModeration system were identified and tabulated. Criteria added to the system quality construct represent context-specific criteria, which differ from the standard criteria used to evaluate an IS. These criteria were compared to those abstracted from the literature so as to identify criteria for inclusion in an eModeration evaluation framework to answer the research questions posed in Chapter One. Participant responses provided valuable insights into the functionality that domain experts believed to be the most important aspects for an eModeration system. The rich data provided by participants after their group discussions offered valuable insights into moderator- and teacher-specific experiences. The domain experts isolated pertinent aspects based on their actual experiences of moderation processes, which not only corroborates but adds to the existing body of knowledge. Domain-specific criteria were added to the flexibility construct. Chapter Six presents the quantitative and qualitative results and findings.

# Chapter 6: Quantitative and Qualitative Results

## 6.1. Introduction

Chapter Five presented the qualitative findings from the PD workshops and concluded with a table comparing the pre- and post-PD criteria (**Table 5-7**), which were used to create instantiations of the artefact. This chapter presents the results obtained from an online survey conducted after participants had interacted with the prototype eModeration system.

This chapter is positioned within the Design cycle of DSR and situates the user in the building, intervention and evaluation component of PADRE. **Section 6.2** presents information on the demographic profiles of the participants. **Section 6.3** reports on the survey response rate. **Section 6.4** reports on the quantitative results from the online survey based on the usability and user experience constructs. **Section 6.5** reports on the qualitative results from the online survey. **Section 6.6** reports on the post survey focus group interviews with members of different faculties in one private secondary school. **Section 6.7** concludes this chapter.

## 6.2. Participant demographics

Forty participants from different faculties of one private school were involved in this study. Of the 40 respondents, 62.5% were female and 37.5% were male, with 11 respondents in the age group 25-34, 9 respondents in the age group 35-44, 14 in the age group 45-54, and 6 respondents being 55 years or older **Table 6-1**.

**Table 6-1: Age groups of respondents**

| Age group | Number | % |
|---|---|---|
| 25 - 34 | 11 | 27.5 |
| 35 - 44 | 9 | 22.5 |
| 45 - 54 | 14 | 35.0 |
| 55+ | 6 | 15.0 |
| **Total** | **40** | **100.0%** |

Respondents indicated their position in the school as faculty head (12.5%), head of department (17.5%), school management (10%), and teacher (60%). The majority of the respondents (77.5%)

indicated their home language as English, while the other home languages of respondents comprised of Afrikaans (10%), isiZulu (7.5%), and French (5.0%). The number of respondents from each faculty is depicted in **Table 6-2.**

**Table 6-2: Number of respondents per faculty**

| Subject | Number | % |
|---|---|---|
| Arts | 2 | 5.0% |
| Business and Commerce | 2 | 7.5% |
| English, Maths and Integrated Studies | 1 | 2.5% |
| Humanities | 5 | 12.5% |
| IT | 2 | 5.0% |
| Languages | 9 | 22.5% |
| Mathematics | 9 | 22.5% |
| Sciences | 9 | 22.5% |
| Total | 40 | 100% |

Of the 40 respondents, 25% participated in their roles as external moderator, 12.5% as internal moderators, 2.5% as regional moderators, and 82.5% as teachers, which is representative of the community.

## 6.3. Survey response rate

A list-based convenience sample was used to recruit participants to complete the online survey at School #1. An initial email (pre-notification) was sent out to all 65 senior school staff on the school email distribution list. The email indicated the purpose of the survey and included links to the prototype and survey. Tracking notifications were selected to ensure that recipients had received the email and had read the message. Several reminders were sent out, and these were followed by personal reminders to teachers on an informal basis. Additionally, reminder emails and links were sent out using the sharing facility provided by Google forms. Forty responses were received, indicating a 61.5% response rate.

## 6.4. Quantitative results from survey

The quantitative data is reported on, based on the usability constructs of ease of use, effectiveness, efficiency, satisfaction, learnability, flexibility, and information quality. The frequency reported as "agreed" is based on strongly agree and agree, and "disagreed" is based on strongly disagree and disagree. **Section 6.4.2** presents the relationship between the identified constructs and **Section 6.4.3** reports on the user experience hedonic qualities.

### 6.4.1. Usability Results

#### 6.4.1.1. Ease of use

The majority of the respondents (90%) agreed that the prototype was simple to use, that there were no inconsistencies (85%), and that it was easy to find the necessary information (87.5%) (see **Table 6-3**). Notably, nobody disagreed that the necessary information was easy to find. A small number of respondents (5.0%) indicated that they were unable to easily recover from mistakes, in contrast to the 77.5% who indicated that they were able to easily and quickly recover from mistakes made when using the eModeration system.

**Table 6-3: Ease of use**

| | The eModeration system is simple to use | | I don't notice any inconsistencies as I use the eModeration system | | Whenever I make a mistake when using the eModeration system, I recover quickly and easily | | It is easy to find the information I need on the eModeration system | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Disagree | 0 | 0.0% | 4 | 10.0% | 2 | 5.0% | 0 | 0.0% |
| Neutral | 4 | 10.0% | 2 | 5.0% | 7 | 17.5% | 5 | 12.5% |
| Agree | 17 | 42.5% | 17 | 42.5% | 23 | 57.5% | 19 | 47.5% |
| Strongly agree | 19 | 47.5% | 17 | 42.5% | 8 | 20.0% | 16 | 40.0% |

#### 6.4.1.2. Effectiveness

A large number (65%) of respondents indicated that the system enabled them to effectively complete their moderation (see **Table 6-4**). The percentage of neutral responses (27.5%) and percentage who disagreed (7.5%) indicate some ambivalence concerning effectiveness, which needs to be investigated further. Most respondents agreed that the eModeration prototype enabled them to be more productive (65%) and met their moderation needs (62.5%). Notably, 72.5% of the respondents agreed that the prototype provided the requisite functionality.

**Table 6-4: Effectiveness**

| | The eModeration system helps me to be more effective in completing the moderation | | The eModeration system helps me to be more productive | | The eModeration system meets my moderation needs | | The eModeration system has all the required functionality to conduct moderation processes | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 2 | 5.0% | 0 | 0.0% | 0 | 0.0% | 2 | 5.0% |
| Disagree | 1 | 2.5% | 5 | 12.5% | 5 | 12.5% | 3 | 7.5% |
| Neutral | 11 | 27.5% | 9 | 22.5% | 10 | 25.0% | 6 | 15.0% |
| Agree | 16 | 40.0% | 15 | 37.5% | 18 | 45.0% | 18 | 45.0% |
| Strongly agree | 10 | 25.0% | 11 | 27.5% | 7 | 17.5% | 11 | 27.5% |

### 6.4.1.3. Efficiency

More than half of the participants (62.5%) agreed that the eModeration system saved them time (see **Table 6-5**), that it was effortless to use the system (62.5%), that no unnecessary actions were required to use the system (70%), and that file transfers were faster (72.5%).

**Table 6-5: Efficiency**

| | The eModeration system saves me time when I use it | | Using the eModeration system is effortless | | The eModeration system does not require any unnecessary actions to accomplish what I want to do with it | | The eModeration system facilitates a faster transfer of files | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 2 | 5.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Disagree | 3 | 7.5% | 9 | 22.5% | 8 | 20.0% | 1 | 2.5% |
| Neutral | 10 | 25.0% | 6 | 15.0% | 4 | 10.0% | 10 | 25.0% |
| Agree | 13 | 32.5% | 11 | 27.5% | 17 | 42.5% | 16 | 40.0% |
| Strongly agree | 12 | 30.0% | 14 | 35.0% | 11 | 27.5% | 13 | 32.5% |

### 6.4.1.4. Satisfaction

Most respondents (87.5%) agreed that they were satisfied with the interface (see **Table 6-6**), would recommend the system to other teachers (72.5%), and that they were satisfied with the functionality provided (75%). Most participants (67.5%) agreed that the system worked in the way that they wanted it to work, while 22.5% were neutral and 10% disagreed. This result highlights the fact that satisfaction is largely impacted by who the user is and the nature of the task.

**Table 6-6: Satisfaction**

| | I am satisfied with the eModeration system interface | | I would recommend the eModeration system to other teachers | | The eModeration system works the way I want it to work | | I am satisfied with the functionality provided by the eModeration system | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Disagree | 0 | 0.0% | 2 | 5.0% | 4 | 10.0% | 3 | 7.5% |
| Neutral | 5 | 12.5% | 9 | 22.5% | 9 | 22.5% | 7 | 17.5% |
| Agree | 22 | 55.0% | 16 | 40.0% | 20 | 50.0% | 22 | 55.0% |
| Strongly agree | 13 | 32.5% | 13 | 32.5% | 7 | 17.5% | 8 | 20.0% |

#### 6.4.1.5. Learnability

The majority of the respondents (90% ) agreed that they learned to easily navigate between the different screens of the system (see **Table 6-7**), that they easily remembered how to use the eModeration system (97.5%), that it was easy to learn how to use the different functions of the system (87.5% ), and that they learned to use the system quickly (92.5%). Notably, none of the participants disagreed that it was easy to remember how to use the system.

**Table 6-7: Learnability**

| | I learned to easily navigate between the different screens of the eModeration system | | I easily remember how to use the eModeration system | | It is easy to learn to use the different functions of the eModeration system | | I learned to use the eModeration system quickly | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Disagree | 1 | 2.5% | 0 | 0.0% | 1 | 2.5% | 1 | 2.5% |
| Neutral | 3 | 7.5% | 1 | 2.5% | 4 | 10.0% | 2 | 5.0% |
| Agree | 21 | 52.5% | 23 | 57.5% | 19 | 47.5% | 16 | 40.0% |
| Strongly agree | 15 | 37.5% | 16 | 40.0% | 16 | 40.0% | 21 | 52.5% |

#### 6.4.1.6. Flexibility

None of the participants disagreed that files and feedback could be accessed from any device (see **Table 6-8**). This finding suggests that the prototype provided the necessary flexibility in terms of accessing files and feedback from more than one type of device. Respondents were neutral (37.5%) about the general flexibility of the eModeration system, with 55% agreeing that the system was flexible. Additionally, 92.5% agreed that the eModeration prototype allowed them to easily upload and download files, and 92.5% agreed that they could use the system in the role of either a teacher or moderator. The flexibility of taking on different roles is important, given the context of use.

**Table 6-8: Flexibility**

| | The eModeration system is flexible | | I can access files and/or feedback using any device | | I can use the eModeration system to upload/ download files easily | | I can use the eModeration system as a teacher or a moderator | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 0 | 0.0% | 0 | 0.0% | 1 | 2.5% | 0 | 0.0% |
| Disagree | 3 | 7.5% | 0 | 0.0% | 0 | 0.0% | 1 | 2.5% |
| Neutral | 15 | 37.5% | 12 | 30.0% | 2 | 5.0% | 2 | 5.0% |
| Agree | 15 | 37.5% | 18 | 45.0% | 24 | 60.0% | 20 | 50.0% |
| Strongly agree | 7 | 17.5% | 10 | 25.0% | 13 | 32.5% | 17 | 42.5% |

#### 6.4.1.7. Information quality

Most respondents (82.5%) indicated that the information provided was clear (see **Table 6-9**). The majority of the respondents (92.5%) agreed that the organization of information on the screens was clear and that the information provided with the system assisted them in completing their work (87.5%). There were 27.5% neutral responses regarding the statement that the eModeration prototype provides error messages that clearly indicate how to fix problems, with 60% agreeing that the system provided clear error messages.

It is notable that none of the participants disagreed on the following:

- The organization of information on the system's screens is clear; and
- The information provided assists in completing work.

**Table 6-9: Information quality**

| | The information (such as online help, on-screen messages, and other documentation) provided with this system is clear | | The eModeration system provides error messages that clearly indicate how to fix problems | | The organization of information on the system's screens is clear | | The information provided with the system assists me in completing my work | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Strongly disagree | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% | 0 | 0.0% |
| Disagree | 4 | 10.0% | 5 | 12.5% | 0 | 0.0% | 0 | 0.0% |
| Neutral | 3 | 7.5% | 11 | 27.5% | 3 | 7.5% | 5 | 12.5% |

| | The information (such as online help, on-screen messages, and other documentation) provided with this system is clear | | The eModeration system provides error messages that clearly indicate how to fix problems | | The organization of information on the system's screens is clear | | The information provided with the system assists me in completing my work | |
|---|---|---|---|---|---|---|---|---|
| | Number | % | Number | % | Number | % | Number | % |
| Agree | 21 | 52.5% | 18 | 45.0% | 25 | 62.5% | 25 | 62.5% |
| Strongly agree | 12 | 30.0% | 6 | 15.0% | 12 | 30.0% | 10 | 25.0% |

### 6.4.2. Relationship between constructs

Multivariate correlations are illustrated in **Table 6-10**; there is a positive linear relationship between the constructs, which indicates a correlation between the constructs.

**Table 6-10: Multivariate correlations**

| | **User experience** | **Ease of use** | **Effectiveness** | **Efficiency** | **Satisfaction** | **Learnability** | **Flexibility** | **Information quality** |
|---|---|---|---|---|---|---|---|---|
| User Experience | 1.0000 | 0.5666 | 0.6763 | 0.6476 | 0.6754 | 0.5955 | 0.5876 | 0.5954 |
| Ease of use | 0.5666 | 1.0000 | 0.5815 | 0.6948 | 0.6479 | 0.5922 | 0.5349 | 0.6462 |
| Effectiveness | 0.6763 | 0.5815 | 1.0000 | 0.6906 | 0.7510 | 0.4253 | 0.5881 | 0.5264 |
| Efficiency | 0.6476 | 0.6948 | 0.6906 | 1.0000 | 0.6585 | 0.6085 | 0.6486 | 0.7036 |
| Satisfaction | 0.6754 | 0.6479 | 0.7510 | 0.6585 | 1.0000 | 0.5391 | 0.5170 | 0.5523 |
| Learnability | 0.5955 | 0.5922 | 0.4253 | 0.6085 | 0.5391 | 1.0000 | 0.4302 | 0.6822 |
| Flexibility | 0.5876 | 0.5349 | 0.5881 | 0.6486 | 0.5170 | 0.4302 | 1.0000 | 0.6475 |
| Information quality | 0.5954 | 0.6462 | 0.5264 | 0.7036 | 0.5523 | 0.6822 | 0.6475 | 1.0000 |

A correlation coefficient (r) measures the strength and direction of a linear relationship between two variables (see **Table 6-11**) on a scatterplot (Rumsey, 2021). The values of "r" are always between -1 and +1 and are used to interpret the strength of the relationship. **Table 6-11** provides an approximate guide for how the strength of the relationship between two variables can be interpreted, based on the absolute value of the coefficient (HR-Statistics, 2016).

**Table 6-11: Interpreting the strength of the relationship (Mindrila & Balentyne, n.d.)**

| **Absolute value of r** | **Strength of relationship** |
|---|---|
| r = 0 | No linear relationship |

| Absolute value of r | Strength of relationship |
|---|---|
| r < 0.3 | None or very weak |
| 0.3 < r <0.5 | Weak |
| 0.5 < r < 0.7 | Moderate |
| r > 0.7 | Strong |

The range of values to determine how strong the relationships are between constructs are categorised in **Table 6-12**. It is important to note that, based on the positive linear relationships between the constructs, only positive values were indicated.

Using the values in **Table 6-11** and the multivariate correlations illustrated in **Table 6-10**, the strength of the relationship between the identified constructs in this study are depicted in **Table 6-12**. A detailed analysis of the relationship between the constructs is presented in **Section 7.3.7**.

**Table 6-12: Strength of relationship between constructs**

| CONSTRUCT | | CORRELATION COEFFICIENT | DIRECTION | STRENGTH |
|---|---|---|---|---|
| User experience | Ease of use | 0.5666 | + | moderate |
| User experience | Effectiveness | 0.6763 | + | moderate |
| User experience | Efficiency | 0.6476 | + | moderate |
| User experience | Satisfaction | 0.6754 | + | moderate |
| User experience | Learnability | 0.5955 | + | moderate |
| User experience | Flexibility | 0.5876 | + | moderate |
| User experience | Information quality | 0.5954 | + | moderate |
| Ease of use | Effectiveness | 0.5815 | + | moderate |
| Ease of use | Efficiency | 0.6948 | + | moderate |
| Ease of use | Satisfaction | 0.6479 | + | moderate |
| Ease of use | Learnability | 0.5922 | + | moderate |
| Ease of use | Flexibility | 0.5349 | + | moderate |
| Ease of use | Information quality | 0.6462 | + | moderate |
| Effectiveness | Efficiency | 0.6906 | + | moderate |
| Effectiveness | Satisfaction | 0.7510 | + | strong |
| Effectiveness | Learnability | 0.4253 | + | weak |
| Effectiveness | Flexibility | 0.5881 | + | moderate |
| Effectiveness | Information quality | 0.5264 | + | moderate |
| Efficiency | Satisfaction | 0.6585 | + | moderate |
| Efficiency | Learnability | 0.6085 | + | moderate |
| Efficiency | Flexibility | 0.6486 | + | moderate |
| Efficiency | Information quality | 0.7036 | + | strong |
| Satisfaction | Learnability | 0.5391 | + | moderate |
| Satisfaction | Flexibility | 0.5170 | + | moderate |
| Satisfaction | Information quality | 0.5523 | + | moderate |
| Learnability | Flexibility | 0.4302 | + | weak |
| Learnability | Information quality | 0.6822 | + | moderate |
| Flexibility | Information quality | 0.6475 | + | moderate |

### 6.4.3. User experience

Respondents rated the system based on 25 Likert scale hedonic qualities. The distribution of responses for Questions 18.1. to 18.26 are depicted in **Figure 6-7**.

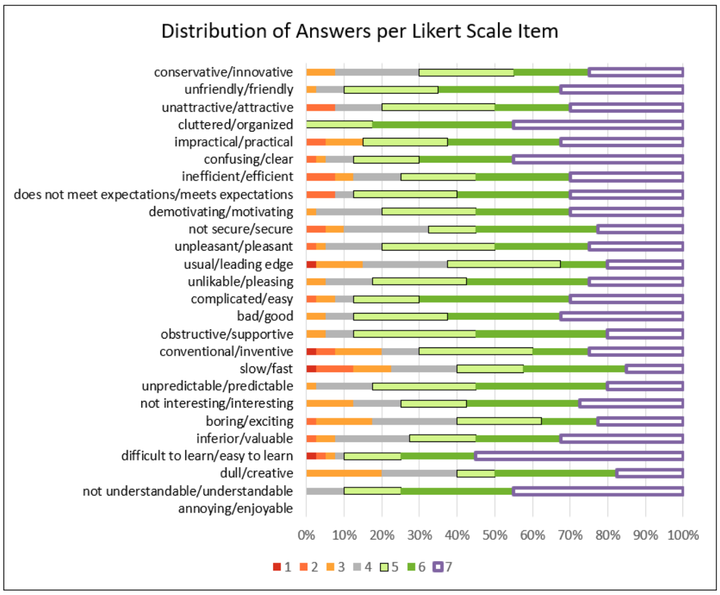



**Figure 6-7: Distribution of responses per Likert scale item**

The values for each item are listed to detect any outliers in the evaluation. An item that shows large deviations from the evaluation of other items of the same scale could be an indication that the item has been misinterpreted by a large number of participants.

Values between -0.8 and 0.8 represent a neutral evaluation of the corresponding scale, values > 0,8 represent a positive evaluation, and values < -0,8 represent a negative evaluation. The range of the scales is between -3 (horribly bad) and +3 (extremely good). Generally, only values in a restricted range will be observed due to the calculation of means over a range of different people with differing opinions and answer tendencies. For instance, it is unlikely to observe values above +2 or below -2 for respondents who tend to avoid extreme answer categories (Schrepp & Thomaschewski, 2020).

Thus, even a quite good value of +1.5 for a scale does not look as positive as it really is on a scale range of -3 to +3. A reduced scale between -2 and +2 was used to compensate for answer tendencies that could have influenced the observed data (see **Figure 6-8**) to provide a more realistic representation of the responses.

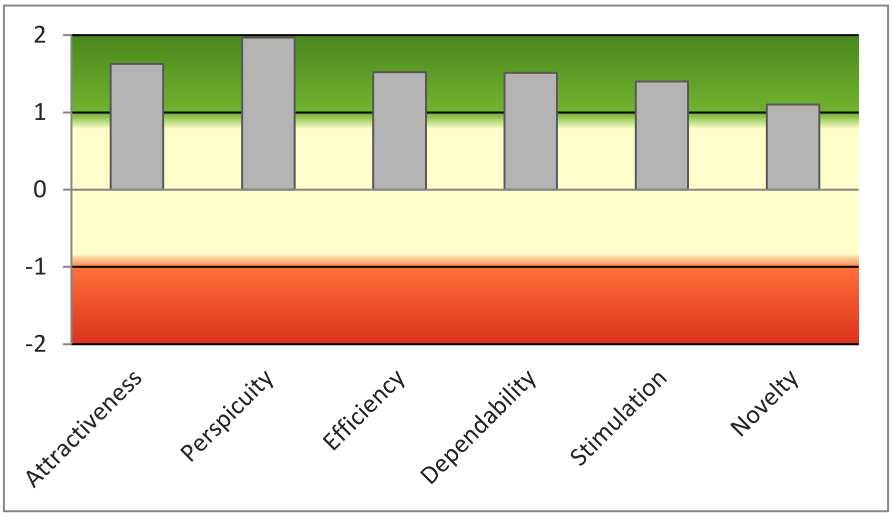



**Figure 6-8: Means of hedonic qualities**

All mean values were above 0.8 (see **Table 6-13**), representing a largely positive evaluation of the prototype in terms of the attractiveness, perspicuity, efficiency, dependability, stimulation, and novelty of the system.

**Table 6-13: UEQ scales for user experience items**

| UEQ Scales | Mean | Variance |
|---|---|---|
| Attractiveness | 1.630 | 1.15 |
| Perspicuity | 1.969 | 0.95 |
| Efficiency | 1.519 | 1.29 |
| Dependability | 1.513 | 0.83 |
| Stimulation | 1.400 | 1.29 |
| Novelty | 1.100 | 1.39 |

The scales were further grouped into task-related quality aspects comprising of perspicuity, efficiency, and dependability, and hedonic, quality aspects such as stimulation and novelty. The attractiveness measure is a valence dimension indicating the user's emotional response to the system. The means of the attractiveness, three pragmatic aspects, and the two hedonic aspects are depicted in **Figure 6-9**. All means were above 1.25, which indicates a positive response to the attractiveness, pragmatic, and hedonic quality of the eModeration system.

| Pragmatic and Hedonic Quality | |
|---|---|
| Attractiveness | 1.63 |
| Pragmatic Quality | 1.67 |
| Hedonic Quality | 1.25 |

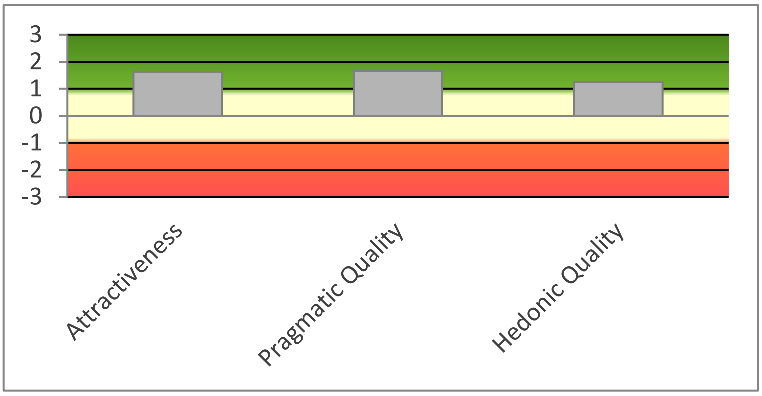



**Figure 6-9: Means of pragmatic and hedonic quality aspects**

The confidence intervals (5%) for the scale means and the means of the single items are depicted in **Table 6-14**.

**Table 6-14: Confidence intervals**

| Confidence intervals (p=0.05) per scale | | | | | | |
|---|---|---|---|---|---|---|
| **Scale** | **Mean** | **Std. Dev.** | **N** | **Confidence** | **Confidence interval** | |
| Attractiveness | 1.630 | 1.070 | 40 | 0.332 | 1.298 | 1.962 |
| Perspicuity | 1.969 | 0.973 | 40 | 0.301 | 1.667 | 2.270 |
| Efficiency | 1.519 | 1.136 | 40 | 0.352 | 1.167 | 1.871 |
| Dependability | 1.513 | 0.913 | 40 | 0.283 | 1.230 | 1.795 |
| Stimulation | 1.400 | 1.138 | 40 | 0.353 | 1.047 | 1.753 |
| Novelty | 1.100 | 1.179 | 40 | 0.365 | 0.735 | 1.465 |

Considering the confidence interval ($p = 0.05$), the results indicate that there is a 5% probability that the results will be the same should the same questionnaire be administered again. This result can be attributed to factors such as the sample size, participant demographics, participant expertise, the context of use (for instance, the subject taught), and the functionality of the system. These results align with a large body of evidence from the technology adoption, HCI, and IS streams emphasizing the impact of the system, task, and user on the user experience and the influence of pragmatic and hedonic factors on users' adoption decisions (Hassenzahl, 2008; Hassenzahl et al., 2010; Law et al., 2009; Mirabolghasemi et al., 2019; Venkatesh et al., 2003; Weichbroth, 2020).

Using data provided with the UEQ, the measured scale means were set in relation to values from a benchmark data set based on 20190 people participating in 452 studies, with products ranging from business software, web pages, web shops, and social networks (Hinderks et al., 2018). As depicted in **Figure 6-10**, the prototype compared favourably to the benchmarks, with all UX scales attaining an overall rating of above average.

The quantitative results around effectiveness, efficiency, learnability, flexibility, and information quality were largely positive, thus pointing to the importance of these constructs in determining the user experience. The responses concerning satisfaction indicate the importance of considering users' subjective reactions to a technology when designing an artefact, as satisfaction largely determines adoption decisions.

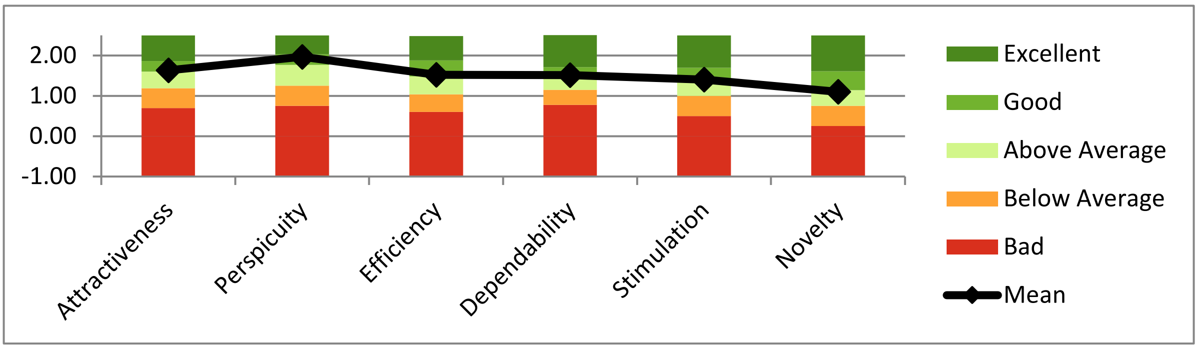



**Figure 6-10: Comparison of means to benchmark**

## 6.5. Qualitative results from online survey

The coding of the qualitative survey data was done using ATLAS.ti® . During the first cycle of coding, the coding groups *challenges, impressions, like, dislike, use*, and *features* were created. During the second cycle, codes were created within each coding group, using the coding group as a prefix; for instance, in the coding group *impressions*, the code *easy to learn* was labelled *impressions: Easy to learn.*

Considering the challenges experienced (see **Appendix E**, Question 19.1), a word list generated in ATLAS.ti® indicated that 40% of the respondents experienced no challenges in using the eModeration prototype. The largest proportion of respondents who indicated that there were no challenges in the use of the system were in the 35 to 44 age group (see **Table 6-15**).

**Table 6-15: Number of respondents per age group who indicated that no challenges were experienced**

| Age group | No. of respondents | Percentage (N = 40) |
|---|---|---|
| 25 – 34 | 4 | 1.0% |
| 35 – 44 | 5 | 12.5% |
| 45 – 54 | 3 | 7.5% |
| 55+ | 1 | 2.5% |

In response to Question 19.2, respondents' overall impressions were positive, centring around the functionality, learnability, and simplicity of the system. Participants indicated that the prototype was efficient, innovative, and functional ("*It is innovative and achieves the purpose*"). Additional responses included the centralization of documents, the ability to provide quick feedback via comments, and efficiency in terms of saving paper and time. Contrary to some responses around the selection of roles being a challenge (in Question 19.1), some participants indicated that they appreciated that they were able to select the appropriate role, as evidenced by the comments *"The drop down options for ease of selection of user type" and "I particularly liked the file organization and the way a moderator could be selected".* Participants agreed that the choices provided would make the system more efficient than the manual moderation process.

Ease of use emerged as a common theme to questions around participants' overall impressions (Question 19.2), as well as features that they liked the most (Question 19.3). Responses were categorised as easy to learn, easy to use, ease of access, and the ease of file transfers, as evidenced by the comments *"The transfer and access to documents is very seamless"*and *"The ease and speed of document transfer. It makes the process easy and less frustrating than other systems I have worked with".*

In response to Question 19.4, aspects that participants disliked centred around annotation using a mouse, connectivity issues, the file format, issues with the interface and logging in, the need to scan files in, security, speed, swopping between moderator and teacher roles, and the connection timing out.

Most respondents indicated that annotating using the mouse was the biggest challenge. The reasons provided were that the process of annotating with a mouse was not only time-consuming, as evidenced by the comment *"Marking with mouse on laptop is time consuming",* but also difficult to accomplish, as evidenced by the comment *"The ability to annotate documents was challenging when using a mouse".*

Five participants had difficulties logging in since they did not grant permission to write the annotated file to Google drive, as evidenced by the comment, *"Took time or struggled a bit in logging in".* Three had difficulty in setting up emails for their profile due to difficulty navigating the moderator/teacher profile (*"Linking email accounts and permissions was quite a challenge").* Participants preferred a demonstration of the functionality over written instructions.

Participants had mixed opinions on file types. Some preferred uploading Word documents, while others were content with PDFs. Some comments were: *"It would be nice if it could accept various files used to create assessments"* and *"I prefer word functionality"*. One participant found uploading PDFs to be perfect as it was a subject requirement.

Additional challenges related to the user interface included the small window size when moderating, requiring scrolling up and down, Internet connectivity issues, the need to scan documents before uploading, slow system speed, and difficulty switching between teacher and moderator roles, with some participants unable to find markup tools (assumed to be only available to moderators).

In response to Question 19.5. most participants indicated they would use an eModeration system for reasons such as centralization, consistency, effectiveness, efficiency, and ease of use. Participants were largely supportive of a digital moderation process that would reduce paper usage, provide benefits for moderation outside their school, and for *"group moderation and feedback discussions"*. Some comments were: "*Having a moderation tool that eliminates the need for pen and paper*" and *"consistent and better for the environment (less paper)"*.

The most frequent response to Question 19.6. was the inclusion of annotation tools. Participants expanded on this idea to include "*Better pen input for annotation", "shortcuts that place ticks and crosses"*, and *"ticks/crosses as stamps for the editing"*.

## 6.6. Post survey focus group interviews

The results of the survey informed the questions for the focus group interviews. The following sections describe the participant demographics and report on the results of the interviews, based on the identified usability and UX constructs (see **Figure 3-14**).

### 6.6.1. Focus Group demographics

Five focus group interviews were conducted with a total of 32 teachers from 8 different faculties of one private school, as depicted in **Table 6-16**.

**Table 6-16: Focus group demographics**

| Faculty | Number in faculty | Number participated in survey | Number at focus group |
|---|---|---|---|
| Commerce, Business and IT | 9 | 4 | 1 x Accounting<br>2 x Business Studies<br>1 x IT |
| Humanities and Arts | 8 | 5 | 2 x Geography<br>1 x Theory of Knowledge<br>1 x Music<br>1 x Art |
| Languages (English, Afrikaans, French) | 17 | 7 | 2 x English<br>3 x Afrikaans<br>2 x French |
| Mathematics | 11 | 8 | 7 x Mathematics<br>1 x Mathematical Literacy |
| Science | 12 | 8 | 3 x Life Sciences<br>5 x Physical Sciences |

Many of the initial respondents to the survey were unable to attend the focus group interviews owing to time constraints. The survey was carried out at the end of the first term and the focus group interviews were conducted at the beginning of the second term. In this time, one teacher had left the school. Two teachers simply forgot to attend. One teacher who had accepted the invitation tested positive for COVID and was therefore unable to join the focus group.

### 6.6.2. Focus group results

The results obtained from the focus group interviews are reported on in the following sections, based on the pragmatic and hedonic qualities that affect adoption decisions. Pragmatic qualities are discussed in terms of the usability constructs of ease of use, flexibility, and learnability. Hedonic qualities are discussed in terms of aesthetics, collaboration and the novelty and stimulation of the eModeration system.

#### 6.6.2.1. Ease of use

When asked about their overall experience of the prototype, most participants immediately commented on how easy it was to use, as is evidenced by the comments: *"I loved it; I found it very easy to use"* (H1) and *"As long as things are clearly labelled, and you know where to click. I found the instructions useful; I knew exactly where to go and the user interface was quite intuitive in* *terms of its design, it made sense, it wasn't frightening, it was logical. It seemed familiar even though it was completely new"* (C1).

Ease of use was the most common response across all focus group interviews in all subject areas.

#### 6.6.2.2. Flexibility

The results concerning the flexibility of the system are reported by considering the subject-specific requirements, changing curricula, the ability to access the system on portable devices, the ability to annotate using additional input devices, and the file types.

- Considering the subject-specific requirements, practical subjects had very different requirements from other subjects. Subject-specific requirements influenced how teachers viewed the interface and how they approached the moderation process. The size of the moderating window was an important consideration for some subjects. For instance, L2 indicated that the system was not flexible due to the *"Size of window; when you have a diagram and you have questions on the diagram, then having to go up and down for moderation. Questions are very long".* The ability to correct or include additional solutions was an issue for subjects such as music where annotations on specifically lined sheets were necessary, as is evidenced by the comment: *"just personally with a very practical subject I found it very difficult to do on the screen. That was one thing that I grappled with"* (H3).

- Considering changing curricula, teachers believed that additional functionality would enhance the flexibility of the system to adapt to possible changes in the curriculum, as is evidenced by the comment: "*if there is a change in syllabus or change in content, then it becomes necessary to, e.g., add diagrams. The application should be able to adapt to these changing requirements"* (M8).

- Considering access on portable devices, participants wanted to easily view the document on a smaller screen and wanted access to documents from devices such as iPads, as is evidenced by the following comments: *"The iPad is one of the devices that you could use this on with a stylus and a pencil so it makes it more accessible to a wider group of people"* (H2).

- Considering the ability to annotate using additional input devices, participants indicated the need to annotate documents using an Apple Pencil (*"could not use an iPad or pencil"* (I1)), and to easily scribble using touch screen functionality (*"Handwriting input – make that more accessible like an iPad or touchscreen laptop so that we can scribble more efficiently"* (M6)). Handwriting-type functionality was a recurrent theme amongst all faculties, with participants from Mathematics emphasizing the ability to *"scribble"*. Additionally, participants wanted specific typesetting for mathematical annotations, as is evidenced by the comment: *"Maths typesetting – we can type and make comments, but the typesetting is not there"* (M7).

- Considering file types, participants indicated that they wanted the facility to upload documents of different file types so that documents were easier to edit, as is evidenced by the comments: *"it needs to incorporate more file types. Maybe even the ability to upload movie clips at a later stage like for I don't know, children performing you know to incorporate more practical elements to subjects"* (H5) and *"Because it is a pdf, I can't adjust it on the pdf. Any changes made on the document must be transferred to the original document"* (I1).

#### 6.6.2.3. Learnability

- Considering the learnability of the system, all participants indicated that the system was easy to learn (*"It wasn't loaded with so many things that it became overwhelming"* (M6)), easy to navigate (*"I liked the idea that you go from one to the other. It is top down, it's not like you go from this menu to that menu ..., you just go"*) (M8), and that they were able to easily complete the moderation *"Because I am technologically challenged, as long as I could follow, I'm perfectly fine. It did that"* (C2).

### 6.6.3. Factors influencing adoption decisions

The factors affecting decisions to adopt an eModeration system centred around the utility of the system, the ease of use and learnability, user characteristics, time, environmental impact, stakeholder buy-in, and the nature of assessments.

- Participants were unanimous that utility would be the most important factor affecting their decision to adopt an eModeration system, as is evidenced by the responses *"Utility is most important"* (C1) and *"Less is more. It fulfilled the function that you wanted"* (M6).

- Participants from all faculties indicated that the ease of use and the learnability of the system would factor into their adoption decisions, as is evidenced by the comments, *"Easy and straight forward, obviously you know we don't have a lot of time. If it's easy to use and you don't have to learn something too much"* (H2) and *"Things being easier and more efficient is number one. If it makes my life more difficult then I couldn't be bothered. I wouldn't even try it"* (M6).

- Considering user characteristics, teachers indicated they would need to have perseverance and be flexible and open-minded, as is evidenced by teacher C3's comment *"understand that the system is new and I'll learn something new"* and *"new things scare people",* so people must be *"willing to learn"*. Language teachers specifically commented that *"When you are marking an essay, I want to comment as I read. It's how we express ourselves"* (E1).

- Considering the time taken for assessment and moderation processes, teachers constantly reiterated the lack of time at all focus group interviews, indicating that if the use of an eModeration system would save them time, then they would be more prone to adopt such a system. Notably, most language teachers indicated that they would not use an eModeration system because it was much faster to write on paper than on a digital copy, as is evidenced by the comment: *"The time that it takes to drag the symbol to the correct spot on the document is much slower than if I were to write it out"* (E2) and *"It's just the time. If it's smooth and quick and efficient from one person to another, then that just makes it better"* (F1). Additionally, the lack of time was articulated in terms of the amount of marking that teachers have daily.

- Considering the environmental impact, teachers agreed that an eModeration system would reduce the amount of paper to be used, as is evidenced by the comment: "*I'd like to get away from so much paper… it's kind of scary that amount of waste. So, I'd like to really cut down on the amount of paper that I use"* (H3).

- Considering stakeholder buy in, participants from the Math, Science, and Art faculties indicated that it would not be worth their time using an eModeration system if other stakeholders were not going to use such a system themselves, as is evidenced by the responses:

*"I could be happy using the tool but will the person I am sending the moderation to be willing to use the tool"* (L1) and *"How widely it is used, you know if it becomes the standard for Music teachers. …You know if you're the only person using it, then is it really functional …"* (H3). An important issue was buy-in by the assessment body: *"Like buy-in from the IEB, like this is how you shall moderate moving forward"* (H5).

- Considering the nature of assessments, the recurrent theme was the current policy requirement for handwritten assessments. The issue was that handwritten assessments need to be scanned in for digital uploads, *"But the kids are still writing (I'm talking about marking) the kids are still writing on paper. They're then having to scan it and then they're marked. So maybe that's an extension"* (H2). An additional problem was that assessment bodies require evidence of handwritten assessments (*… they can hand it in on Teams or Google whatever I'm using and generally what I do at the moment just because in matric you have to have a hard copy to put into their portfolio, so you print it right to mark"* (H1)).

### 6.6.4. Benefits to using a dedicated eModeration system

All faculties acknowledged the benefits of a dedicated eModeration system in terms of file storage and security, productivity, continuity, and transferability.

- Considering file storage and security, a dedicated system would provide the benefit of centralization of files and an organized structure *("I think that the filing structure because it's done by the system, by some algorithm and has access to your drive, I like that. Because as soon as I have to moderate things and it's in my documents and I move to my OneDrive and have to move it somewhere and here and there, I often forget."* (L3)) and a *"sense of security; safe place that nobody could hack into"* (I1).

- Considering productivity, participants agreed that a digital moderation system would positively impact on their productivity. Participant M7 indicated that *"you know you are going to the system to do a specific task to moderate. Using a dedicated program, you are going on to do just what you want to do so that helps from a productivity side as well"*.

- Considering continuity and transferability, a dedicated eModeration system would be beneficial in ensuring a sense of continuity when new members of staff are employed, as indicated by the comment: *"A new person coming into the school can see that this is what the moderation processes look like in this school…"* (C1). Files would remain with the school, thus ensuring continuity and transferability: *"Continuity – accounts are linked to school; there needs to be a transfer. Also, department/faculty heads can see the moderation without having to share yet another folder. It becomes an organizational tool to whom the tests and assessments belong"* (C1).

- Teachers had mixed opinions on using an eModeration system for assessed scripts. Some expressed concerns about the time required to scan written assessments and the availability of specific annotation tools, as well as the use of stylus-type inputs. However, if the moderation was content-related, no challenges were indicated. The results suggest that the success of eModeration systems depends on providing the necessary functionality to suit user needs.

### 6.6.5. Additional functionality to include in an eModeration system

Considering additional functionality, participants indicated the need for stamping tools, the ability to customize the interface, the provisioning of templates, and the integration of a voice note facility.

- Considering the inclusion of additional stamping tools, participants indicated the need to easily tick and cross when assessing, as is evidenced by the comment: *"If there was a tick checkmark stamp, that would be cool"* (L3). A related aspect was participant A1's and L2's suggestion that emojis should be included.

- Participants showed a preference for customization options for the interface, with a desire for accessibility features such as font size and colour preferences (*"Accessibility as it sets up, you could select colour-preferences like at the opening and font sizes potentially …"* (E2)), as well as softer edges for visually impaired users. These comments suggest that the ability to customize the interface to individual needs is an important consideration for users of the eModeration system.

- Participants across different faculties indicated the need for templates in the eModeration system, for more efficient moderation and to provide proof of moderation. They suggested that the system should have options to save moderation templates and to fill out the moderation form at the end of the process. Comments to this effect were: *"Different schools and different places may have different forms. Maybe have an option somewhere to save that moderation template ..."* (S2) and *"Maybe at the end of the moderation have an option like: Do you want to fill out the moderation form? If you say yes, then it will bring up that form"* (S1).

- Participants suggested the integration of voice notes to save time and quickly leave comments for either the teacher or the moderator. This would allow for easier and faster communication, especially for nuanced suggestions: *"Voice notes – sometimes it is easier to describe what you are saying, instead of writing it on every page, there is a general voice note. It is sometimes much easier for us if we are in a hurry instead of typing in"* (M4).

#### 6.6.5.1. Aesthetics

Most participants from all faculties indicated that the aesthetics of the system were unimportant, articulating that, *"Aesthetics is not important; as long as it is functional .."* (C1). However, teachers from the Mathematics faculty believed that aesthetics is important, as it would determine their willingness to use the system and could impact its uptake. These teachers felt that a visually appealing system would result in better uptake, regardless of functionality, indicating: *"Your brains make connections to the way that things look. If it is visually appealing and you know that you have to do moderation, then you are more willing to go into the app"* (M1).

#### 6.6.5.2. Collaboration

All participants concurred that an eModeration system is a very useful tool for collaboration, specifically when moderating across schools as evidenced by the comment: *"Perhaps it should be about doing something across town"* (L1). In this regard, the inclusion of voice notes and chat facilities would facilitate external communication.

#### 6.6.5.3. Novelty and Stimulation

Participants unanimously indicated that the functionality of the system was far more important than the novelty or the stimulation, indicating that *"the functionality trumps everything else*" (H5) and *"we've got enough excitement in our lives as teachers, we just want something that works nicely. Just get the job done" (H3).*

## 6.7. Conclusion

Chapter Six provided a discussion of the results of the online survey and the focus group interviews with members of eight different faculties. The discussion was structured around the reliability of the measuring instrument, a presentation of the results of the quantitative data, and a presentation of the qualitative results. The findings indicate that teachers value efficiency in terms of time and effort expended, annotation tools, and an easy to use as well as a visually pleasing interface. A key finding is that the nature of assessments, as stipulated by assessment bodies, makes it more difficult for teachers to migrate towards a digital system due to the time and effort required to scan handwritten documents for digital submissions. Chapter Seven presents an analysis of the results towards developing an initial eModeration evaluation framework.

# Chapter 7: Data analysis and findings

## 7.1. Introduction

Chapter Six presented the quantitative and qualitative results from the online survey and from the focus group interviews. The objective of this chapter is to answer the third research question: *How can independent secondary school teachers contribute to the design and validation of a user experience evaluation framework for an eModeration system?* This chapter is positioned within the Evaluate phase of the Design cycle of the DSR process and situates the users' contributions in the building, intervention and evaluate stage of the PADRE cycle. **Section 7.2** presents an analysis of the results. **Section 7.3** presents a discussion of the pragmatic, usability qualities based on ease of use, effectiveness, efficiency, satisfaction, learnability, flexibility, and information quality. **Section 7.4** presents a discussion of the user experience (hedonic) qualities. **Section 7.5** outlines the implications of the key findings. **Section 7.6** presents a tabular comparison (see **Table 7-1**) of the criteria identified from the literature review, the criteria extracted from the PD workshops, criteria elicited from the data analysis of the survey responses, and the data obtained from the focus group interviews. An initial evaluation framework divided into pre- and post-usage criteria is presented (see **Table 7-2**). **Section 7.7** concludes this chapter.

## 7.2. Data analysis

Keywords from the open-ended survey questions and focus group interviews were used to identify main themes in ATLAS.ti® (see **Section 6.5**). The discussion of the qualitative data is structured around the identified themes, as it was necessary to interrogate challenges in the use of the prototype, aspects that participants disliked about the system, aspects that participants liked about the system, and the functionality that should be included in an eModeration system to foster an in-depth understanding of user needs, so that relevant criteria could be extracted for evaluation. The sample size is too small (N = 40) for statistically significant results indicating the reason for some of the findings discussed in the following sections.

### 7.2.1. Challenges identified or experienced with the eModeration system

Members of specific faculties experienced more challenges than others when interacting with the prototype. This finding can be attributed to different subject areas having differing needs in terms of their moderation, as is evident from the comment, *"As I teach Accounting, formats and layouts are very important and I don't know if this will work as well with these type of assessments"* (C2).

Considering file formats, respondents indicated that they would have preferred to work with documents in their native file formats. Since the challenges associated with the prototype are related to the dislikes, the following section first reports on the dislikes. Secondly, responses to the challenges are compared to those of the dislikes.

### 7.2.2. Dislikes associated with the eModeration system

An analysis of aspects that participants disliked is presented by considering the lack of student–teacher interaction, speed of the moderation process, Internet connectivity, security, and file types.

One participant indicated a *"lack of student–teacher interaction"* as an aspect that they disliked. Considering that the purpose of an eModeration system is to provide a teacher who has assessed student work with feedback, the system had not been designed to provide student–teacher communication. This is possibly a future extension where the system can provide added functionality for students to view their assessments.

Participants indicated that slow Internet speed was a significant barrier to the effective use of the system, impacting the speed at which they were able to upload and download files, as well as access the moderation system. This was evidenced by comments such as: *"It takes a lot of time to download all the documents, which makes the process much slower"* (S4) and *"It can be frustrating when the internet is slow, which affects the speed at which I am able to access and moderate the assessments"* (M2). While participants who mentioned that the system was slow were in many instances referring to uploading and downloading of files, they were also in some instances referring to the actual digital moderation process as being slower than the manual, hard copy process. Language teachers specifically articulated speed as a challenge when integrating technology, indicating that the time taken to create a text box and align it with the content that they wished to comment on was a laborious process which could be accomplished much faster when moderating on paper.

Considering security, participants had varying opinions on granting access to their Google Drive folder for the use of the moderation system prototype. While one participant expressed concern about security, the younger teachers (27.5%, N = 40) were more comfortable granting permission, as they were accustomed to giving access to applications. The use of Google Drive as the backend for saving assessments and moderated documents in the free version of the prototype may have contributed to the differing opinions on security.

Considering file types, the moderated assessments being returned as a .png file rather than a .pdf file was an important criticism of the prototype. Teachers specifically wanted to keep track of version histories, and the prototype did not satisfy this need. This finding underscores the importance of an eModeration system providing the functionality to track changes and to provide a version history. This finding is consistent with the findings of Heinrich, Milne, Crooks, and Granshaw (2006) in the context of assessing student work, and Van Staden (2017) and Rajamany (2020) in the context of an eModeration system.

In summary, survey participants indicated that customization, templates, voice note integration, aesthetics, speed, security, and file type support were important factors to consider when developing an eModeration system. They preferred a system that was easy to use, efficient, and that provided version history tracking. Participants from the Mathematics faculty particularly valued aesthetics, while speed was an issue for language teachers. Security concerns were raised, but younger teachers were more comfortable granting permission to access their Google Drive folder. These criteria were flagged as of primary importance in evaluating the user experience of an eModeration system and were included as evaluation criteria.

### 7.2.3. Likes associated with the eModeration system

Two categories of responses were obtained regarding what participants liked about the prototype. First, in terms of the existing functionality and what was good about it, respondents identified the annotation tool and the fact that there are different colours available for use, the ability to provide feedback and make annotations as well as recommendation on the documents, the ability to select comments, and the centralization of documents. Secondly, participants responded in terms of the ease of use and efficiency. A word cloud generated in ATLAS.ti® indicates that ease of use was the most frequent response concerning aspects that respondents liked. Easy access and easy navigation were identified as aspects of ease of use, which were reiterated by participants of the focus group interviews. Concerning efficiency, participants liked that the eModeration system was paperless, thus encouraging sustainability and saving them time.

The implementation of an eModeration system depends on teachers' and moderators' buy-in of the system. Aspects factoring into teacher and moderator adoption decisions are discussed in the following section.

### 7.2.4. Adoption decisions

Based on the coded themes in ATLAS.ti® , adoption decisions are presented based on the task requirements for individual subjects, the nature of assessments, stakeholder buy-in, and the functionality to be included.

#### 7.2.4.1. Task requirements

The subject-specific requirements influenced how the eModeration system should be designed, as well as how teachers approached the moderation process. Teachers from different faculties clearly had preferences based on their subject-specific task requirements. There were two distinct approaches:

i. The moderation of assessed scripts; and

ii. The moderation of assessment content.

Teachers had mixed opinions on using an eModeration system for assessed scripts. Some expressed concerns about the time required to scan written assessments and the availability of specific annotation tools, as well as the use of stylus-type inputs. However, if the moderation was content-related, no challenges were indicated. The results suggest that the success of eModeration systems depends on providing the necessary functionality to suit user needs. These findings confirm studies that indicate that performance impacts are realized when the technology provides the requisite functionality to suit the needs of users (Tripathi & Jigeesh, 2015).

Language teachers specifically experienced the eModeration system as a challenge, articulating a preference for a more practical tool. The reasons voiced during the survey and the focus group interviews included the nature, number, and volume of assessments.

There was a very clear preference for the use of the system in the context of content moderation (A2:*"I would prefer to use it as a moderating tool rather than a moderation tool"*), with moderation and collaboration across schools and regions being the focus. Teachers regarded the use of an eModeration system for the purposes of quality assurance of the content as a matter of convenience and a necessity arising from the geographical dispersion of schools; and could readily see the need and benefits of such a system in this context. This finding aligns with a large body of evidence supporting the importance of online moderation practices for collaboration between teachers in diverse locations, for instance Adie (2010), Connolly et al. (2012), and Adie (2013).

The task requirements for individual subjects differ. For instance, in line with the identified challenges, a respondent indicated a concern about her subject-specific needs being met in terms of the moderation of formulae, equations, and others. Notably, teachers' differing views in terms of their specific task requirements affected their adoption decisions. These findings support literature findings that task requirements have a significant effect on users' adoption decisions. If a system does not suit individuals' task requirements, then they may not adopt the technology (Zhou et al., 2010). It is therefore necessary to be cognisant of secondary school teachers' subject-specific task requirements when evaluating whether an eModeration system suits their subject-specific needs.

#### 7.2.4.2. Nature of assessments

An important consideration factoring into teachers' adoption decisions was the current nature of assessments. Anecdotal evidence points to student assessments being largely handwritten. As repeatedly evidenced by the comments made, the large amount of scanning to be done so that digital moderation processes could be carried out was not worth teachers' time and effort. Therefore, unless policy changes are made at a national level within education departments regarding the nature of assessments, an electronic moderation system is impractical.

#### 7.2.4.3. Stakeholders buy-in

Buy-in from other stakeholders, for instance moderators at other schools, was a factor affecting adoption decisions. Teachers articulated that if other moderators were not willing to carry out digital moderation processes, then it would be pointless for them to do so. However, participants who said that they would not use a digital moderation tool conceded that if such a system was mandated, they would use it, as is evidenced by the comment: *"Unless it is mandated, we are told that we need digital proof of moderation when it comes from top down you don't have choice then it is essential"* (E2).

### 7.2.5. Functionality to be included in an eModeration system

The functionality that participants thought should be included in the eModeration system is discussed in terms of collaboration and customization of the system to enhance teachers' effectiveness.

#### 7.2.5.1. Collaboration

Most participants indicated that an eModeration system would be useful for regional moderation. For instance, Participant S1 indicated that the use of an eModeration system *"shrinks the gap"*, especially *"if you are moderating something externally, it's a nice way to get stuff to the external moderator without having to print and scan you know that whole thing"*. Thus, it is necessary to include tools that will allow moderators and teachers to seamlessly interact and collaborate with each other, especially when the moderator is *"in another country…"* (E2).

#### 7.2.5.2. Customization

Survey respondents indicated that they would not use the eModeration system in its present form. Focus group participants clarified the exact customizations that were necessary for the eModeration system to be practically useful. These customizations included additional annotation and stamping tools, shortcuts, integration with other applications, and voice notes, which are discussed further in the following paragraphs.

Although annotation tools were included in the prototype, participants were dissatisfied with the level of tools provided. Participants specifically wanted ticks and crosses that could be dragged and dropped. Hence, annotation tools went through a process of refinement. Whereas the literature mentioned generic tools and participants in PD mentioned annotation tools in passing, participants who interacted with the prototype articulated very specific needs concerning the availability of specific annotation tools. For instance, language teachers indicated that the system *"has a lot of potential but it is just not practical. We want to be able to just quickly tick and cross"* (A1). Empirical evidence points to the importance of suitable annotation tools, with teachers indicating the importance of being able to include arrows and circles. All teachers at the focus group agreed that annotation tools were an important requirement of an eModeration system, which aligns with the affordance of annotation tools in electronic marking (Johnson & Greatorex, 2008; Vergés Bausili, 2018).

A related aspect was the addition of shortcut keys. Participants indicated that shortcuts that placed ticks and crosses would be invaluable. Additionally, including an autohide functionality for the annotation toolbar would enhance the interface and create the space that certain subject teachers wanted.

Participants requested an integration of the eModeration system with OneDrive, Google Classroom, and Word. This integration has the potential to increase the productivity of moderators and teachers, as student work can be *"instantly batched and moderated"*. Literature is supportive of this finding, indicating that a well-integrated system leads to easy-to-understand and consistent outputs, as well as complete and accurate information relevant to decision making (Gorla et al., 2010).

Suggestions to include voice notes was an important customization that was repeatedly mentioned across all sources of data. While literature made mention of a voice-over button (which PD workshops participants reiterated together with voice notes), survey participants mentioned the facility for audio/video feedback. Focus group participants mentioned the inclusion of voice notes and clarified that moderation would be much easier if they were able to quickly leave a voice note, specifically in instances where comments needed to be based on the nuances of the question rather than its factual content. The voice-over button was replaced by voice notes in the final criteria, purely in terms of semantics and the emphasis on this feature amongst focus group participants.

Survey and focus group participants recommended the inclusion of multi-user technology, qualifying it as the need for multiple moderators. Similar to the findings of Heinrich et al. (2006), focus group participants identified a need for more than one moderator to work on the document at the same time and in different colours, so that they could reach a consensus on the moderation, eliminate the duplication of comments, and keep track of who had made the comment.

Notably, participants at PD workshops asked for specific functionality to be assigned to specific roles. Thus, once logged in as a moderator, the prototype was designed to recognize any subsequent logins as a moderator role based on the email provided. However, when actively involved in the moderation process, teachers with multiple roles wanted access as teachers as well as moderators. Focus group participants indicated a need for a clear differentiation between the roles of moderator and teacher so that there would be no confusion, which is consistent with the initial designs created during PD workshops. Participant C1 further suggested that a drop-down list could be created so that users could *"toggle"* between roles.

Aligned with the literature (Vergés Bausili, 2018) and PD workshops, focus group participants indicated that email notifications that documents have been moderated was a useful feature to include.

## 7.3. Usability

In answering research question three, the criteria to evaluate the usability of an eModeration system are discussed based on the effectiveness, efficiency, satisfaction, learnability, and flexibility constructs, as outlined in the theoretical framework (see **Figure 3-14**).

### 7.3.1. Effectiveness

While the survey responses indicate some measure of ambivalence towards this construct, participants of the focus groups specifically indicated that an eModeration system would enable them to effectively complete the moderation process. As part of the effectiveness measure, the quality of the task outcome is an important aspect in the use of an eModeration system. Additionally, it is important that the eModeration system should provide the requisite functionality to complete moderation processes and enable teachers to be more productive, as empirical evidence points to teachers not having time (Hamlaoui, 2021; Schulz et al., 2015). A lack of time was reiterated during each focus group interview. Therefore, being able to effectively complete the moderation processes enhances productivity.

Relevant annotation tools, customizable comments, an audit trail, built-in templates, and the ability to choose the moderator and provide feedback were criteria that participants specifically identified as contributing to the effectiveness of an eModeration system.

### 7.3.2. Efficiency

Focus group participants identified timeliness, quick response, and productivity as aspects of efficiency, while data from literature and PD workshops indicated cost savings, saving paper, tracking, and the inclusion of customizable comments as aspects of efficiency.

The majority of the survey respondents indicated that the eModeration system saved them time and that the use of the system was largely effortless. A large number (80%) of focus group participants articulated the need for faster processing, uploading, and downloading of documents, which is supportive of Cioloca et al.'s (2013) assertion that any software system must be efficient in order for it to be considered a success. Additionally, a survey respondent indicated that the eModeration system would maximize collaboration while minimizing the administrative effort of using the system. In addition to time, other aspects of efficiency that were raised at the PD workshops included the amount of paper saved, and the ability to save courier costs or the cost of driving to a central location to deliver files for moderation; these were reiterated in survey responses and focus group interviews, and are consistent with extant literature (Van Staden et al., 2019).

### 7.3.3. Satisfaction

The utility, usability, visual appeal, and hedonic qualities influence the satisfaction levels experienced by users when interacting with a system (Hassenzahl, 2008). Furthermore, (Hassenzahl, 2008) includes the popularity, stimulation, and quality perception of users as additional factors influencing the satisfaction of users. Despite the majority of the survey respondents expressing satisfaction with the interface (see **Table 6-6**) and the functionality provided, one participant commented on the interface not being attractive, while another indicated that the interface was very basic. Focus group interviews confirmed a level of satisfaction with the interface. This finding aligns with literature indicating that user satisfaction with a system leads to increased usage and a perception of the system as being beneficial (Mtebe & Raisamo, 2014).

### 7.3.4. Learnability

The ease of learning depends on the type of user and the task being attempted (Lew et al., 2010). A large proportion (90%) of the survey respondents indicated that they easily learned how to navigate the system. All focus group participants (N = 32) concurred, indicating that the prototype was intuitive, that they were able to use the system quite easily, and that the instructions enhanced the learnability of the system. Lew et al. (2010) demonstrate the need to consider learning from various user perspectives, as learning observed for new users is not necessarily related to continued learning. Further, learnability is directly linked to usability (Lew et al., 2010). Thus, an eModeration system must be learnable as learnability affects adoption decisions and teacher motivation, which is evidenced by the comment "*if it is difficult, then you are frustrated and feel stupid*" and "*if I go there and am trying but can't get it right ... for me if I have fiddled and I can't get it right then I want something else. I want an easier way to do it"* (C2).

Lew et al. (2010) note several user group types, including:

- Level of experience with computers;
- Level of experience with interface;
- Level of related domain knowledge; and
- Experience with similar software.

Therefore, user group types and their influence on learnability is of paramount importance when evaluating an eModeration system. This finding confirms empirical evidence that indicates that learnability, as a performance criterion related to efficiency and effectiveness, is important for consumer products (Law et al., 2008).

### 7.3.5. Flexibility

An analysis of the data suggests that flexibility is an important aspect of an eModeration system. While survey respondents indicated that the prototype was flexible, focus group discussions provided some conflicting results. This finding can be attributed to the fact that many survey respondents had not spent sufficient time working with the prototype. Further, survey responses were based on the specific questions of whether respondents could access files and/or feedback using any device, use the prototype to upload/ download files easily, and use the eModeration system in their roles of teachers or moderators. The results indicate that respondents were able to easily transfer files and successfully use the prototype in their roles as either moderator or teacher. However, the results did not provide adequate responses concerning the adaptability of the system to scenarios that had not been considered in the questionnaires, as is evidenced by the comment: *"It did what it needed to do, but like I said we thought of so many things that could improve it. So it's not that it wasn't flexible. It's just that there are things that could make it more flexible"* (S1).

Focus group participants were vocal concerning the flexibility that they required of an eModeration system. Based on the results, flexibility is discussed in terms of the subject-specific changes in curricula, accessibility via portable devices, the ability to annotate using additional input devices, file types, and the provisioning of templates for pre- and post-moderation forms.

Considering subject-specific requirements, teachers required the eModeration system to be flexible in accommodating the differing needs of various subjects. For instance, in languages and subjects such as History and Geography, written essays require specific types of feedback as codes. On the other hand, subjects such as Accounting require specific layouts to represent different types of books, while Mathematics and Science require the incorporation of specific equations. A suggestion for subject-specific flexibility was to allow teachers to select the functionality that they would require at the beginning of their interaction with the system and turn off those aspects that they would not need. L2 expressed this idea as: "*you optimize your own experience. So, in the beginning you choose what functionalities you need then the others you can switch it off almost"* and participant L3 articulated as: *"the ability to turn off or on certain functions. I consider that flexibility. It would be important because there might be tools that the English department might need that I don't want around while I'm doing it. Like switch things off"*.

These subject-specific findings were not evident in the literature reviewed. A possible reason for this finding could be that many teachers were directly interacting with a dedicated eModeration system for the first time and their responses were based on an authentic account of their lived experience, which confirms Schulz et al.'s (2015) assertion that teachers should be considered amongst the key stakeholders when designing ICT tools for education. Furthermore, Schulz et al. (2015) recommend that not only should teachers be included at every step in the design process, but they should also be more involved in designing ICT tools for education. The data analysis thus indicates that it is necessary to adapt the functionality provided to cater for the incorporation of subject-specific requirements.

Considering changing curricula, Participant M5 indicated that it is important for the application to adapt to any changes in the syllabi or content (e.g., the ability to add diagrams at a later stage due to specific changes in assessments). An important suggestion in this regard was the inclusion of functionality to provide feedback to the developers. This view was echoed and expanded on at the focus group interview by Participant C2, who indicated that it would be useful for developers to provide the flexibility of allowing users to use the system for a year, after which the developer should be willing to *"build any additional functionality that you require. Developers must be flexible so that updates can be made; there has to be contact or collaboration so that this information can be fed back to the developer"*. This finding is noteworthy when evaluating the user experience of an eModeration system and speaks to the scalability of such a system. It is important that the functionality of the system is adaptable to unanticipated changes in curricula, and that it is able to accommodate future needs. It would be pointless to commit financial resources to a system that cannot adapt to changes in requirements.

Considering accessibility via portable devices, the consensus was that the prototype was not flexible, with respondents indicating an inability to use an iPad (0.15%) or Apple Pencil (0,2%) to scribble with. Additionally, participants commented on the resolution that did not change when using the system on a portable device. A suggestion was to provide *"a pdf enhancement so that it would be easier to use the system on a smaller screen"* (M8).

Concerning accessibility via portable devices, the ability to annotate using additional input devices such as a pencil, which would allow greater flexibility in terms of annotations, was a recurrent theme. Participants indicated that annotating hard copy assessments was effortless and factored into their meaning-making, as is evidenced by Participant E1's response: *"I can't think straight on technology"*.

Consistent with Johnson and Greatorex's (2008) finding that, despite the availability of annotation tools, underlining, circling, and highlighting were used less in digital marking than on paper. Participant E2 commented that *"we're gonna spend more time typing, sizing the box so that it does not obscure the box behind it whereas my skill level at working into every crack and margin on paper…".* An important consideration, as identified by Johnson and Greatorex (2008), is that of parallax that usually occurs on touch screen devices. The result of the data analysis aligns with this finding, as is evidenced by the comment, *"I wanted to correct this phrase and then it shifted and then I want to draw an arrow. Then it is not aligned"* (E1).

Focus group participants indicated that the eModeration system needs to incorporate more file types. Teachers indicated the need to include Word documents so that changes could be tracked. Tracked changes would ensure that changes would be less laborious and that no changes would be missed, which is particularly important when moderating examinations.

During PD workshops, many participants mentioned including rubrics and moderation templates in the form of pre- and post-moderation forms that could be filled in during the moderation process. This functionality was not built into the eModeration prototype. Repeated comments during focus group discussions underscored the importance of incorporating templates to facilitate the ease of the moderation process. A related concept was the provisioning of a split-screen functionality to enable the templates to be viewed side by side with the actual assessment being moderated.

All participants agreed that flexibility is an important component to enable incorporation of different subjects, different styles of moderation, and different styles of questions. The system would need to *"adapt to a whole bunch of other things that even we at this table couldn't think of"* (S2). Despite one participant in the focus group indicating that they did not believe that the flexibility was *"a reflection of the efficacy of the system"* and that "*for our purposes, we don't need the system to be flexible"* (C1), other results point to the necessity for including flexibility as a construct in the evaluation of an eModeration system.

### 7.3.6. Information quality

Most respondents (92.5%) agreed that the information presented was clear and organized and that the interface was easy to understand. Information quality is dependent on the quality of the data and deals with the content and the format of the information presented to the stakeholder (Gorla et al., 2010). Additionally, Gorla et al. (2010) maintain that user satisfaction can be measured indirectly through information quality. Lew et al. (2010) argue for the inclusion of information quality as a quality in use measure for software applications. Given that the quality of the content presented to the user is an important aspect of an eModeration system, a decision was taken to integrate information quality as part of the overall quality of an eModeration system.

#### 7.3.7. Relationship between usability constructs

As indicated by the correlation coefficients reported on in Chapter Six (see **Table 6-10**), there was a positive relationship (i.e., the values for one variable increase as the values for the other variable increase) between all constructs.

There was a weak relationship between:

i. Learnability and effectiveness (0.4253); and

ii. Learnability and flexibility (0.4302).

There was a strong significant relationship between:

iii. Effectiveness and satisfaction (0.7510); and

iv. Efficiency and information quality (0.7036).

The weak relationships between learnability and effectiveness suggest that learnability and effectiveness are independent of each other. The system could be easy to learn, but this does not mean that its use is more effective. Additionally, it is possible that the system was not difficult to learn. This fact was confirmed by focus group participants who agreed that the system was easy to use.

Similarly, learnability and flexibility are discrete constructs that do not impact each other. While the system may be easy to learn, there is no expectation that it is also flexible. This result could be attributed to a difference of opinion among participants. For instance, one person may believe that the system is not flexible whilst another may believe that the system is not learnable. The findings from the focus group discussions confirm this belief. Many respondents believed that the system was not flexible due to the inability to use mobile devices easily and effectively with stylus-based inputs. In contrast, all participants believed that the system was easy to learn. Additionally, the relationship between learnability and other constructs, for instance, ease of use, satisfaction, and efficiency was either moderate or strong, indicating that participants found the prototype easy to learn. Although learnability was not an issue in this particular system, the learnability construct should be included in an evaluation framework as there is no guarantee that the same participants will experience another eModeration system as easy to learn.

The strong relationship between points (iii) and (iv) suggests that users will attain a greater level of satisfaction when completing moderation if the system is more effective. Additionally, the system will not require a greater amount of time and effort to be expended in attaining a greater level of productivity.

Furthermore, all other relationships were moderate with the relationships for the following approaching 0.7, thus indicating a strong correlation between these constructs:

v. Ease of use vs efficiency;

vi. Efficiency vs effectiveness; and

vii. Learnability vs information quality

The moderate relationships between efficiency and learnability, efficiency and satisfaction, and efficiency and flexibility indicate that, as one construct decreases, the other also decreases. The moderate relationship between efficiency and learnability does not align with Lew et al.'s (2010) observation that software that is easy to learn is not always efficient to use, and vice versa. However, Lew et al.'s (2010) finding that learnability depends on the domain of the software, the target users, and the task at hand provides a plausible explanation for the moderate relationship between learnability and efficiency.

If the efficiency with which the user can accomplish a task decreases, it is reasonable to assume that the user’s satisfaction would decrease. The moderate relationship between efficiency and satisfaction align with Lew et al.’s (2010) assertion that not only is there an expectation that the system must work and help users to accomplish their tasks, but there is also an expectation that the system is pleasant to use and that it provides satisfaction to the user. In affirmation, focus group responses indicate that efficiency and ease of use are the most important considerations in users' adoption decisions, as is evidenced by comments that they would not *"even try it"* (M6) if it made *"life more difficult"* (S2).

## 7.4. User Experience Hedonic Qualities

The Likert Scale responses from the survey provide a basis for a discussion around the hedonic qualities of user characteristics and aesthetics.

### 7.4.1. User characteristics

A large body of literature has reiterated issues such as time, training, resources, and teacher resistance to change as the main impediments to the acceptance of ICTs in the learning environment (Gambo et al., 2017; Hamlaoui, 2021; McFarlane, 2019). For instance, Schulz et al. (2015) indicate that 18% of educators from ten different countries indicated a lack of training to use new tools and a lack of infrastructure as reasons for not integrating new ICT tools in the classroom.

Contrary to the literature findings, an analysis of the focus group results indicates that teachers are not inherently resistant to the use of technology per se but are experiencing what E2 termed *"learning fatigue"* and L3 described as: *"you get the irritation of having to learn a new system"*. This finding is consistent with that of the brainstorming session of the PD workshops, where most teachers indicated that they were enthusiastic about trying out a new system with the important proviso that the system must be efficient, functional, and easy to learn. Additionally, teachers prefer a system that will provide an organized structure so that all the necessary items can be easily accessed.

Hamlaoui (2021) considers teachers' lack of digital confidence as a psychological barrier to ICT adoption. These barriers arise from a fear of failure, a fear of losing time, or a fear of not getting the expected results. Contrary to Hamlaoui's (2021, p. 178) finding of the fear of failure "to be a major barrier" to the integration of ICTs, in this thesis, only one teacher expressed a fear of making a mistake and not being able to go back to fix the mistake. Upon further probing, it was evident that this fear arose from using a previous system that did not afford him the opportunity of rectifying any mistakes. This finding corroborates Adie's (2011) view that teachers' negative reactions to technology may prevent them from fully participating in the online moderation practice. It is therefore necessary to ensure that appropriate error messages, a back button, and messages confirming user choices are integrated into the user interface of an eModeration system.

While acknowledging that it would be possible to complete tasks faster with repeated use (E2), many teachers at the focus group interviews indicated that they did not have the time to learn and implement a new system. The issue of the time needed to accustom themselves to something new was a recurrent theme in all focus group interviews, as is evidenced by the comment: *"If I don't have to go through a whole learning curve to learn how to use the program then I am going to be happy to try it out"* (M7). This finding confirms studies indicating that the most frequent reasons why teachers do not integrate new ICT tools are time constraints (47%) and a "fear of losing time" (Schulz et al., 2015; Hamlaoui, 2021, p. 128).

The actual technology was also a factor in some teachers' reluctance to adopt an eModeration system, as several teachers regarded digital moderation as more time-consuming than the manual, paper-based process. Possible reasons are the lack of suitable annotation tools and the inability to annotate using stylus-based input and touchscreen facilities. A related issue was the number of assessments to be completed, exacerbating the issue of time.

### 7.4.2. Personal preferences

Contrary to Hamlaoui's (2021) findings that teachers with more years of experience seem more resistant to any kind of change, it is significant that many of the teachers indicated that they were quite willing to try new things. The findings indicate that teachers not wanting to use an eModeration system was not as a result of an aversion or resistance to the use of technology, as indicated by E2's response *"We can have all the aptitude on the planet, but when it's preference we are going to go back there"* (referring to paper-based moderation); but, in many instances a matter of personal preference largely determined by the subject, nature of assessments, and number of students. For instance, language teachers and those teaching practical subjects were not only adamant that they would never use the system, but also insisted that they preferred hardcopy. This finding correlates with Chia's (2016) view that teaching subjects correlate with teachers' attitudes toward technology. Additionally, a language teacher indicated that, irrespective of how good the technology was, she simply preferred paper and would not move away from paper-based assessments or moderation reflecting that "*I am not a Luddite, I like using technology for many things, just not marking and moderation"* (E1) which is consistent with findings that standard marking actions are significantly harder to perform online (Vergés Bausili, 2018).

These findings are consistent with the view that teachers seem to generally have a positive but cautious view of technology, and that prior experience with technology correlates significantly with positive attitudes (Chia, 2016).

#### 7.4.3. Moderation as a social process

Language teachers indicated that, with digital moderation, "*you feel absent from the process"* (E2) and "*language teachers have similar characteristics. We are social, interactive, and communicative"* (E1). This notion of social moderation is not a new concept, having been extensively explored by Adie (2011), Adie et al. (2013), Newhouse and Tarricone (2016), and Adams and Anderson (2019). Adams and Anderson (2019, p. 4) additionally indicate that the drive to grow moderation as an approved process has resulted in a large body of "interpretivist research sharing a common ontology of moderation as a socially constructed and socially situated practice". It is through this "community of practice" (Adams & Anderson, 2019, p.4) that professional development occurs, increasing teachers' "assessment literacy" (p. 5). It is therefore evident that teachers will need to develop new skills to become proficient with the communication challenges of online moderation. These findings suggest that an eModeration system will need to include functionality for collaboration that will mimic the real-world experiences of teachers in the form of a chat facility. This finding is consistent with the inclusion of a video and live chat or feedback facility identified from the literature reviewed, the PD workshops, the survey, and the focus group interviews.

### 7.4.4. Aesthetics

There was a mixed reaction to the importance of the aesthetics of the interface. While one survey respondent indicated that the *"Interface is not attractive"*, another respondent indicated that *"It did look great aesthetically."* Although care was taken to ensure that the prototype was visually pleasing, the emphasis during development was on the functionality. Whilst participants agreed that the functionality and ease of use of the system are far more important than the aesthetics, there was general agreement that the aesthetics of the system did impact on adoption decisions.

Participants who identified aesthetics as important also indicated that, when an application is first opened and it is "*neat*", "*tidy and easy to navigate*" one is more prone to use the system, as is evident from the comment that "*a program that is more appealing will get a better uptake regardless of the functionality*" (M6). A possible explanation for this finding is the demographics of the participants. Notably, all of those who indicated that aesthetics was an important factor were from the Mathematics department. Of those who stressed the importance of aesthetics and the interface being attractive, 50% were in the 25 to 34 year age group, with 20% of this group having taught for less than a year. While the overall finding indicates that the aesthetics are unimportant compared to the functionality and ease of use of the system, there is reason to consider the aesthetics when evaluating an eModeration system as subjective judgements do play a role in determining ultimate adoption decisions, specifically in the younger cohort.

### 7.4.5. Accessibility

Accessibility is defined as "the usability of a product, service, environment or facility by people with the widest range of capabilities" (Bevan, 2008, p. 14). Notably, focus group participants generally agreed that the colours of the system made a difference to its accessibility. An important finding in this regard is the consideration of people who are visually impaired. The data suggests that the prototype was not fully accessible, as accessibility was only mentioned in the focus group interviews. Thus, while this factor was not evident at a theoretical level, it is notable that the interaction with a prototype foregrounded the issue of accessibility for the visually impaired. This finding aligns with the view that a "designerly mode of enquiry is distinct from scientific and scholarly approaches" (Bannon & Ehn, 2012, p. 45), validates the use of participatory design as a data capturing strategy, and is consistent with Bannon and Ehn's (2012, p. 42) assertion that a failure to pay attention to the design of the "social subsystem" when developing the "technical subsystem" leads to poor performance and a failure of IT systems. An important contribution from focus group participants was the need for functionality that enables users to choose colour schemes, especially for visually impaired people.

An important consideration was for the developers of an eModeration system to allow users to actively engage with the system for a period, and thereafter to provide feedback on possible upgrades and functionality to include. Another suggestion in this regard was the provision for users to provide feedback somewhere on the system.

Participant L1's observation that *"There is something different about looking at it on a piece of paper, you see things that are not seen on the computer. I make a lot of mistakes when moderating on screen. I don't seem to notice them as much"* aligns with research indicating that moderators who examined hardcopy versions noticed evidence that had been overlooked by other moderators who had previously assessed the digital version of the same assessments (Johnson & Greatorex, 2008). A related aspect is that the mode of reading fosters the implementation of different reading strategies (Johnson & Greatorex, 2008; Shaw, 2008).

Designing for accessibility becomes an imperative in the eModeration context. This finding is consistent with empirical evidence suggesting that reading on the screen creates a greater cognitive load on the moderator (Johnson & Greatorex, 2008). Possible reasons, as articulated by Shaw (2008), include inter-line spacing, the contrast between fonts and the background, navigation, and the visual layout of text. The findings indicate that the eModeration system should be designed with accessibility in mind, particularly for visually impaired users. The system should include functionality that allows users to choose different colour schemes to improve accessibility. The system should be designed to take into account the different reading strategies and cognitive load associated with reading on a computer screen.

### 7.4.6. Novelty and stimulation

The novelty of a system contributes to its hedonic quality by fulfilling peoples' underlying need to be stimulated (Hassenzahl & Tractinsky, 2006). An analysis of the survey results indicates that most responses around the novelty, stimulation, and dependability of the prototype were neutral.

However, focus group interviews revealed that functionality and ease of use were more important in the given context. A comparison of the rating of the prototype to the benchmark (see **Figure 6-10**) indicates that the eModeration prototype was rated above average, specifically with regard to novelty and stimulation; this aligns with the fact that most participants had not used a dedicated eModeration system before.

Given that this sample is very small, there is no evidence to indicate that the novelty and stimulation would not matter to other groups of teachers. Literature suggests that, while novelty and stimulation may not necessarily fulfil current goals, they could be important in accomplishing future goals (Hassenzahl, 2003). Furthermore, Hassenzahl (2003, p. 5) maintains that "the stimulation provided by novel, interesting, or even exciting functionality, content, presentation, or interaction style will also indirectly help goal fulfilment". In line with Schulz et al.'s (2015) argument that teacher-centred ICT tools should be capable of enhancing teachers' motivation, irrespective of their knowledge or skills, and participant M8's comment that *"if it is not visually appealing, you don't have the energy to go to the next step"*, it was decided to include novelty and stimulation in the evaluation framework.

## 7.5. Implications of findings

A triangulation of findings indicates that teachers want a system that is easy to use, uncluttered, and simple. The findings indicate that teachers prefer a system that is functional, innovative, useful, accessible, and flexible.

The results from the survey and focus group interviews are a direct result of teachers' experiential evaluation of the prototype eModeration system. This approach provides a holistic understanding of the system by considering both system-oriented and experiential evaluations. This method allows teachers to provide personal and subjective evaluations of their experiences with the system, rather than solely describing the system's attributes (Hassenzahl et al., 2010). Furthermore, by comparing the results of empirical evaluations with experiential evidence, the findings are more context dependent. Hassenzahl et al. (2010) argue that if experience is only reflected by system attributes, then valuable insights may be missed if people assume that system attributes alone are responsible for the experience. Therefore, incorporating system-oriented and experiential evaluations is crucial for understanding the effectiveness of an eModeration system.

Significant findings based on participants' experiential evaluation contribute largely to the final criteria that were included in the eModeration evaluation framework. The criteria elicited from all sources of data collection are depicted in **Table 7-1.** In answering the research question, the formulae

= IF(OR(C2="✔", D2="✔"), "✔", "**x**")

and

=IF(AND(B2<>"✔", E2), "✔", "**x**")

(where B2 represents the criteria extrapolated from the extant literature, C2 represents the criteria obtained from the PD workshops, D2 represents the criteria elicited from the survey, and E2 represents the data obtained from the focus group interviews) were applied to the data in the column labelled "Teacher criteria" to produce context-specific teacher-based criteria for the evaluation of an eModeration system (see **Table 7-1**) to include criteria that were either evident in all sources of evidence or that were identified from the focus group interviews.

The results reveal that the eModeration system's accessibility for visually impaired teachers and the capability for personalization were key considerations for its adoption. Despite the majority of the focus group participants (87%; N = 32) indicating that aesthetics was unimportant, their experiences and feedback suggest that aesthetics do play a role in the acceptance of an eModeration system. The inclusion of functional features such as shortcut keys, stamping tools, built-in templates, toggle role, and integration with other applications were deemed essential for improving the effectiveness and efficiency of the moderation process.

**Table 7-1: Comparison of criteria**

| Criteria | Literature review | PD workshops | Survey | Focus group | Include in framework ? | Criteria | Literature review | PD workshops | Survey | Focus group | Include in framework ? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Accessibility | | | | ✔ | ✔ | Navigation | | | | ✔ | ✔ |
| Accuracy | ✔ | ✔ | | | x | Notifications | ✔ | ✔ | ✔ | ✔ | ✔ |
| Aesthetics | ✔ | | | ✔ | ✔ | Online editing | ✔ | ✔ | ✔ | ✔ | ✔ |
| Annotation tools | ✔ | ✔ | ✔ | ✔ | ✔ | Organized file structure | ✔ | ✔ | ✔ | ✔ | ✔ |
| Audit trail | ✔ | ✔ | ✔ | ✔ | ✔ | Open-mindedness | | | | ✔ | ✔ |
| Automatic updates | ✔ | ✔ | ✔ | ✔ | ✔ | Output quality | ✔ | | ✔ | ✔ | ✔ |
| Availability | ✔ | | | | x | Perseverance | | | | ✔ | ✔ |
| Built-in templates | ✔ | ✔ | | ✔ | ✔ | Personalization | | | | ✔ | ✔ |
| Calendar | ✔ | ✔ | ✔ | ✔ | ✔ | Platform independent | | ✔ | ✔ | ✔ | ✔ |
| Capability | ✔ | | | | x | Productivity | ✔ | | ✔ | ✔ | ✔ |
| Centralized data storage | ✔ | ✔ | ✔ | ✔ | ✔ | Progress bar | ✔ | ✔ | | | x |
| Checklist | ✔ | ✔ | ✔ | | x | Quick response | ✔ | ✔ | ✔ | ✔ | ✔ |
| Choose moderator | ✔ | ✔ | ✔ | ✔ | ✔ | Reduced printing | ✔ | ✔ | ✔ | ✔ | ✔ |
| Collaboration | | ✔ | ✔ | ✔ | ✔ | Reliability | ✔ | ✔ | ✔ | ✔ | ✔ |
| Compatibility | ✔ | ✔ | | | x | Reminders of deadlines | ✔ | ✔ | | ✔ | ✔ |
| Completeness | ✔ | | | | x | Reporting | ✔ | ✔ | ✔ | ✔ | ✔ |
| Complexity | ✔ | | | | x | Response time | ✔ | ✔ | ✔ | ✔ | ✔ |
| Confidence | ✔ | | | ✔ | ✔ | Robust hardware specifications | ✔ | ✔ | ✔ | | x |

| Criteria | Literature review | PD workshops | Survey | Focus group | Include in framework ? | Criteria | Literature review | PD workshops | Survey | Focus group | Include in framework ? |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cost saving | ✔ | ✔ | | | x | Satisfaction with functions | ✔ | ✔ | ✔ | ✔ | ✔ |
| Cross platform | ✔ | ✔ | ✔ | ✔ | ✔ | Security | ✔ | ✔ | ✔ | ✔ | ✔ |
| Customizable comments | ✔ | ✔ | ✔ | ✔ | ✔ | Security of information | ✔ | ✔ | ✔ | ✔ | ✔ |
| Data currency | ✔ | ✔ | | | x | Self-efficacy | ✔ | | ✔ | ✔ | ✔ |
| Database of comments | ✔ | ✔ | ✔ | ✔ | ✔ | Shared folders | | ✔ | ✔ | ✔ | ✔ |
| Dependability | ✔ | ✔ | ✔ | ✔ | ✔ | Shortcut keys | | | ✔ | ✔ | ✔ |
| Ease of learning | ✔ | | ✔ | ✔ | ✔ | Split screen | | | | ✔ | ✔ |
| Ease of use | ✔ | ✔ | ✔ | ✔ | ✔ | Stamping tools | | | ✔ | ✔ | ✔ |
| Environmentally friendly | ✔ | ✔ | ✔ | ✔ | ✔ | Synchronization | ✔ | ✔ | ✔ | ✔ | ✔ |
| External communication | ✔ | ✔ | ✔ | ✔ | ✔ | Task performance | | ✔ | ✔ | ✔ | ✔ |
| FAQ | | ✔ | | | x | Technical support | ✔ | ✔ | ✔ | ✔ | ✔ |
| Flexibility | ✔ | ✔ | ✔ | ✔ | ✔ | Ticketing help system | | ✔ | | | x |
| File formats | ✔ | ✔ | ✔ | ✔ | ✔ | Time saving | ✔ | ✔ | ✔ | ✔ | ✔ |
| Functional help | ✔ | ✔ | ✔ | ✔ | ✔ | Timeliness | ✔ | ✔ | ✔ | ✔ | ✔ |
| Instant feedback | ✔ | ✔ | ✔ | ✔ | ✔ | Toggle role | | | | ✔ | ✔ |
| Integration with cloud storage | | ✔ | | ✔ | ✔ | Tracking changes | | ✔ | ✔ | ✔ | ✔ |
| Integration with Google Classroom / cluster manager | | | ✔ | ✔ | ✔ | Tracking deadlines | | ✔ | ✔ | ✔ | ✔ |
| Internet connectivity | ✔ | ✔ | ✔ | ✔ | ✔ | Tracking documents | ✔ | ✔ | ✔ | ✔ | ✔ |

| **Criteria** | **Literature review** | **PD workshops** | **Survey** | **Focus group** | **Include in framework ?** | **Criteria** | **Literature review** | **PD workshops** | **Survey** | **Focus group** | **Include in framework ?** |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Legibility | ✔ | | | ✔ | ✔ | Training and Experience | ✔ | | ✔ | ✔ | ✔ |
| Live chat/feedback | ✔ | ✔ | ✔ | ✔ | ✔ | Usefulness | | | ✔ | ✔ | ✔ |
| Multiple roles | | ✔ | ✔ | ✔ | ✔ | User friendly | | ✔ | ✔ | ✔ | ✔ |
| Multiple subject integration | | ✔ | ✔ | ✔ | ✔ | Versioning | | ✔ | ✔ | ✔ | ✔ |
| Multi-user authentication | | ✔ | ✔ | ✔ | ✔ | Voice notes | ✔ | ✔ | ✔ | ✔ | ✔ |
| Multi-user technology | ✔ | ✔ | | | x | Web-based | | ✔ | ✔ | ✔ | ✔ |

## 7.6. Initial evaluation framework

The eModeration evaluation framework was developed by considering the findings from the literature review, PD workshops, survey, and focus group interviews. The criteria for evaluation were chosen based on existing usability constructs and hedonic attributes from technology adoption models, HCI, and IS success models, and grouped under three components: the user, the task, and the system (see **Figure 3-12**) The criteria were ordered alphabetically (**Table 7-2**) to avoid duplicates and were informed by an OR operation in Excel to include items that appeared in all four sources of information or items specifically identified by participants in the focus group interviews (see **Section 7.5**). This approach emphasized participants' subjective experiences with the prototype. Thus, more prominence was given to these criteria, which were grounded in the context of use.

The tick ( ✔ ) indicates that the criterion is evident in that source, while the cross (**x**) indicates that the criterion has not been included in the framework. The criteria were integrated and refined to ensure they were specific and relevant to the eModeration system.

Self-efficacy, which refers to an individual's confidence in their ability to use a system (Mirabolghasemi et al., 2019), was included as a criterion, and ease of use and user-friendly were replaced with the usability constructs of user efficiency and user effectiveness. Additionally, customizable comments were combined with a database of comments, and legibility was integrated with output quality. Open-mindedness, which was identified in the focus group interview, was left out of the framework as it is a state of mind that is independent of the system and outside the scope of the requirements of an eModeration system. Productivity was incorporated into user effectiveness. Reduced printing was incorporated into environmentally friendly. Quick response and timeliness were incorporated into response times. Security of information and security were combined to provide a more general criterion. Shared folders was incorporated into centralized data storage. Stamping tools was incorporated into the more generic criterion of annotation tools, so that different types of annotation and not just subject-specific tools could be provided.

**Table 7-2: Initial eModeration evaluation framework**

| | | |
|---|---|---|
| User | **Pre- and post-usage criteria** | |
| | User preferences | |
| | **Post-usage criteria** | |
| | Ease of learning | User effectiveness |
| | Self-efficacy | User efficiency |
| | Training and experience | User satisfaction |
| | Usefulness | |
| Task | **Pre- and post-usage criteria** | |
| | Annotation tools | Multiple roles |
| | Audit trail | Multiple subject integration |
| | Automatic updates | Multi-user authentication |
| | Built in templates | Navigation |
| | Calendar | Notifications |
| | Choose moderator | Online editing |
| | Collaboration | Organized file structure |
| | Complexity | Shortcut keys |
| | Database of comments | Task performance |
| | Environmentally friendly | Toggle role |
| | External communication | Tracking changes |
| | Flexibility | Tracking deadlines |
| | Functional help | Tracking documents |
| | Instant feedback | Versioning |
| | Live chat/feedback | Voice notes |
| | **Post-usage criteria** | |
| | Split screen | |
| System | **Pre- and post-usage criteria** | |
| | Accessibility | Platform independent |
| | Centralized data storage | Reliability |
| | Cross platform | Reminders of deadlines |
| | File formats | Reporting |
| | Integration with cloud storage | Security |
| | Integration with Google Classroom/Cluster Manager | Synchronization |
| | Output quality | Technical support |
| | **Post-usage criteria** | |
| | Aesthetics | Personalization |
| | Dependability | Response time |
| | Internet connectivity | Web-based |

The saving of time was evident in all four streams of data collection. Given that time saving speaks to efficiency, it was incorporated as an aspect of user efficiency.

## 7.7. Conclusion

Chapter Seven presented a discussion of the results of the online survey. The discussion was structured around the reliability of the measuring instrument, a presentation of the results of the quantitative data, and a presentation of the qualitative data results. Context-specific criteria were elicited based on a comparison of results from all sources of evidence (see **Table 7-1)**, with an emphasis on aspects that specifically arose as a direct result of interaction with the prototype eModeration system. A comparison of the criteria abstracted from literature, participatory design workshops, an online survey, and focus group interviews resulted in the extraction of refined criteria (see **Table 7-2**) for the evaluation of the user experience of an eModeration system. The results indicate that teachers value the utility of the eModeration system the most. Participants also value a system that is quick and easy to use effectively, efficiency in terms of time as well as effort expended, customized annotation tools, and an easy to use as well as a visually pleasing interface that is accessible to various types of users. Chapter Eight presents the final validated eModeration evaluation framework, based on an evaluation by domain experts.

# Chapter 8: Evaluation of framework

## 8.1. Introduction

Chapter Seven presented an analysis of the quantitative and qualitative results from the online survey and the focus group interviews that were conducted at School #1. A comparison of the results obtained from the literature review, PD workshops (during which design requirements were elicited), online survey, and focus group interviews (**Table 7-1**) formed the basis for the development of an initial eModeration evaluation framework (**Table 7-2**) based on the usability and user experience constructs identified in the theoretical framework as developed in Chapter Three (see **Figure 3-14**).

Research questions one and two were answered in Chapter Two (**Table 2-9**). Research question three was answered in Chapter Seven (**Table 7-2**). The objective of this chapter is to answer the main research question presented in Chapter One namely *What are the components of a user experience evaluation framework for electronic moderation systems for secondary schools?* (see **Section 1.4**).

This chapter is positioned within the Design and Rigor cycles of the Design Science Research process. **Section 8.2** outlines the criteria extrapolated from literature that were used in the evaluation of IT artefacts, which in this research is an evaluation framework. **Section 8.3** describes the theoretical grounding of the evaluation process. **Section 8.4** reports on the results of the expert interviews. **Section 8.5** describes the method used to analyze the data obtained from the expert interviews. **Section 8.6** presents a discussion on the refinement of the evaluation framework based on the identified themes. **Section 8.7** presents the refined evaluation framework (see **Table 8-5**), together with guidelines (see **Table 8-6**, **Table 8-7** and **Table 8-8**) to assist stakeholders including teachers, moderators, and ICT managers in evaluating an eModeration system. **Section 8.8** concludes this chapter.

## 8.2. Evaluation criteria

Venable et al. (2016) identify the dual nature of the evaluation of artefacts as comprising of:

➢ The need to focus on evaluating an artefact's utility in its context of use (the Relevance Cycle of DSR); and

➢ The need to consider the artefact in the context of the knowledge it contributes (the Rigour Cycle of DSR (Venable et. al.., 2016).

Evaluation as a core component of DSR provides evidence of the utility and relevance of designed artefacts (Coetzee, 2019). As recommended by Sonnenberg and vom Brocke (2012, p. 395), it was necessary to demonstrate the evaluation framework's fit "to its purpose and scope". The objective of the evaluation activity was to validate the utility and applicability of the proposed evaluation framework. To this end, a list of criteria commonly used in evaluating IT artefacts, together with the domain of use, were extracted from literature, as depicted in **Table 8-1**.

**Table 8-1: Evaluation criteria from literature**

| Evaluation criteria | Synonyms | Reference | Domain | | | |
|---|---|---|---|---|---|---|
| | | | Construct | Model | Method | Instantiation |
| Utility | Usefulness<br>Accuracy | Hevner et al. (2004); Peffers et al. (2007); Fischer (2011); Prat et al. (2014); Van Biljon (2020). | | | | ✔ |
| Quality | - | Hevner et al. (2004). | | | | |
| Efficacy | - | Hevner et al. (2004); Prat et al. (2014). | | | ✔ | ✔ |
| Effectiveness | - | Aier and Fischer (2011). | | | | ✔ |
| Efficiency | - | Aier and Fischer (2011). | | | ✔ | ✔ |
| Consistency | Internal consistency<br>External consistency | Peffers et al. (2007); Prat et al. (2014); De Laat (2019). | | ✔ | ✔ | |
| Comprehensiveness | Broad purpose and scope<br>Completeness | Peffers et al. (2007); Prat et al. (2014);<br>Olivier (2009); De Laat (2019). | ✔ | ✔ | | |
| Simplicity | Understandability | Peffers et al. (2007); Aier and Fischer (2011); Prat et al. (2014). | ✔ | ✔ | ✔ | |

| Evaluation criteria | Synonyms | Reference | Domain | | | |
|---|---|---|---|---|---|---|
| | | | Construct | Model | Method | Instantiation |
| Fruitfulness of new research findings | - | Peffers et al. (2007). | | | | |
| Ease of use | - | Aier and Fischer (2011). | ✔ | | ✔ | |
| Accuracy | - | Aier and Fischer (2011). | | ✔ | | |
| Generality | Transferability | Prat et al. (2014) Van Biljon (2020). | | ✔ | ✔ | |
| Clarity | - | Olivier (2009); Aier and Fischer (2011); Prat et al. (2014); Van Biljon (2020). | | ✔ | | |
| Conciseness | Exactness Parsimony | Olivier (2009); Prat et al. (2014). | | ✔ | | |
| Legibility | - | Prat et al. (2014). | | | | |

Hevner et al. (2004) argue that when assessing the quality attributes of an artefact, criteria that are relevant to the contextual requirements of the environment in which the artefact will be implemented should be selected. In line with this view, the evaluation of the eModeration framework was informed by criteria from the works of Olivier (2009), Aier and Fischer (2011), Prat et al. (2014), and Van Biljon (2020) as presented in **Table 8-1**. Utility, completeness, simplicity, generality, parsimony, and clarity were deemed the most appropriate criteria in evaluating the initial eModeration evaluation framework. **Section 8.3** explicates the theoretical grounding for the evaluation of the eModeration evaluation framework by analyzing the relevance of the selected evaluation criteria to the eModeration context.

## 8.3. Theoretical grounding of evaluation process

Statements of truth in DSR primarily relate to "what could and what should be" and "how useful things are expected to be" (Sonnenberg & vom Brocke, 2012, p. 384). Additionally, the creation of an artefact precedes an understanding of its functioning (Sonnenberg & vom Brocke, 2012). It is therefore necessary for design decisions to be validated through evaluations before the artefact is implemented. Accordingly, **Table 8-2** presents a description of each evaluation criterion and the reason for its relevance in evaluating the eModeration evaluation framework with a focus on the expected utility of the eModeration framework.

**Table 8-2: Evaluation criteria**

| Evaluation Criteria | Description | Reference | Motivation for inclusion and/or applicability to eModeration framework |
|---|---|---|---|
| Utility | Utility determines how well the artefact achieves its main purpose and works in a real context of use. | Aier and Fischer (2011); Sonnenberg and vom Brocke (2012); Venable et al. (2016). | The eModeration evaluation framework is only useful if it is relevant to the context of use and can solve a practical problem. It is necessary to determine if the eModeration evaluation framework is useful for evaluating an eModeration system that can be implemented in the secondary school environment. |
| Completeness | The framework addresses all or most aspects of the problem in an unambiguous, clearly understandable way. | Hevner et al. (2004); Olivier (2009). | The eModeration evaluation framework is understandable, easy to interpret, and unambiguously satisfies the requirement of comprehensively evaluating an eModeration system. |
| Simplicity | Simplicity makes it possible to easily understand the constructs that increase user acceptance. | Aier and Fischer (2011); Hevner et al. (2004); Olivier (2009). | A simple eModeration evaluation framework will enable different types of users to apply the framework to an eModeration system and engage in communication around its use. |
| Generality | The degree to which the artefact broadly addresses its goal and adapts to modifications of a problem. | Aier and Fischer (2011); Olivier (2009); Prat et al. (2014). | A broad scope will provide for a more efficient application of the eModeration evaluation framework. |
| Parsimony | Refers to the artefact's ability to fulfill the purpose it was designed for so that users are not burdened with irrelevant information. | Hevner et al. (2004); Olivier (2009). | The more closely the eModeration evaluation framework is applicable to evaluating an eModeration system, the greater its acceptability will be. |
| Clarity | The interaction between components and the purpose of each component should be obvious so that content can be quickly and accurately communicated. | Pursel (2010); Sonnenberg and vom Brocke (2012). | Having a clear vision of the usefulness of each component within the eModeration evaluation framework is essential to understanding its purpose. |

A naturalistic evaluation investigates how a technological solution functions in the intended environment and is pertinent to this research due to its characteristic of evaluating human interactions with real systems in real environments. Additionally, naturalistic evaluations are empirical and tends towards interpretivism, which is the data collection and analysis strategy employed in this research (Venable et. al, 2016).

An ex-ante evaluation, on the other hand, is conducted before a technology is acquired or developed; it aims to determine whether it is suitable for its intended purpose and to compare it to competing technologies (Venable et. al, 2016). Sonnenberg and vom Brocke (2012) maintain that it is necessary to validate all design choices by evaluating design decisions in the use of an artefact. An ex-ante evaluation was used to validate the design decisions made in developing the initial eModeration evaluation framework (**Table 7-2**) by implementing the eModeration prototype (see **Figure 8-1**) with a focus on demonstrating the prototype's utility and extracting UX evaluation criteria (Sonnenberg & vom Brocke, 2012).

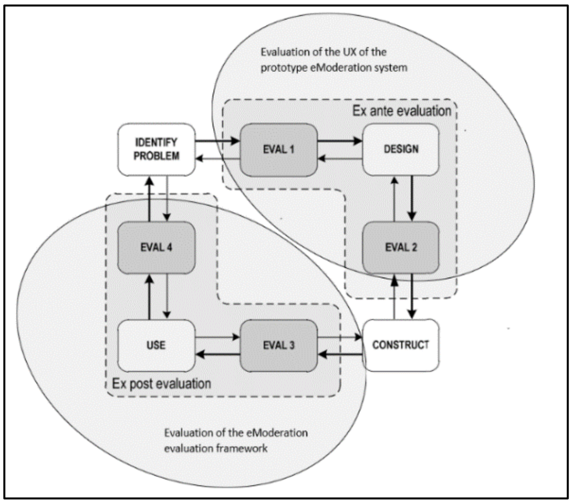



**Figure 8-1: Ex ante and ex post evaluation of artefacts applicable to eModeration based on Sonnenberg and vom Brocke (2012).**

While ex-ante evaluations validate the design of an artefact, ex-post evaluations validate artefact instances and artefacts in use. Ex-post evaluations are conducted after an artefact has been created (Sonnenberg & vom Brocke, 2012). An ex-post evaluation was used to validate the eModeration evaluation framework (**Table 7-2**) during the Rigour Cycle of the DSR process (see **Figure 4-1).**

The evaluation criteria depicted in **Table 8-2** were selected to inform the design of semi-structured interview questions to guide the evaluation of the eModeration evaluation framework (**Table 7-2**). The process to evaluate the framework comprised expert interviews, as depicted in **Figure 8-2**.

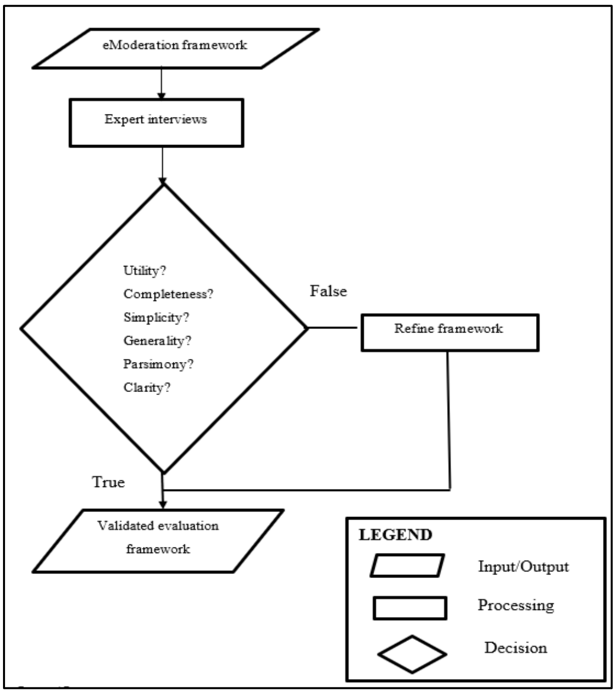



**Figure 8-2: Evaluation process**

The framework was refined based on the analysis of the results after expert evaluation, using the criteria of utility, completeness, simplicity, generality, parsimony, and clarity. The next section describes the development of the interview instrument, followed by a presentation of the demographics of the interviewees.

### 8.3.1. Interview instrument

The interview questions were created to evaluate the framework with moderators (at both national and cluster levels), teachers, examiners, members of assessment bodies, and IT managers to confirm the relevance of the evaluation criteria outlined in **Table 8-2**. The interview questions (see **Appendix G b)**) were formulated based on the evaluation criteria outlined in **Table 8-2**. An information sheet (see **Appendix G a)**) describing the evaluation criteria was provided to interviewees before the scheduled interviews. The following section describes the participant demographics.

### 8.3.2. Participant demographics

The framework was evaluated by eight domain experts who were purposively selected for their expertise in moderation and teaching, as well as for the use of technology. The participant demographics is depicted in **Table 8-3**.

**Table 8-3: Demographics of evaluators**

| Role | Age group | Experience in role (no of years) | Highest professional qualification | Subject area |
|---|---|---|---|---|
| Teacher | 45 - 55 | 20 | Ph.D | Technology |
| Subject specialist | 25 - 35 | 1 | B.Ed | IT |
| Executive manager: Material development | 45 - 55 | 1 | Ph.D | All subjects administered by the assessment body |
| National examiner and moderator | 45 - 55 | 26 | Masters | IT |
| National examiner and moderator | 65 - 75 | 40 | Ph.D | English |
| IT Manager | 35 - 45 | 15 | Diploma | ICT management |
| National examiner and moderator | 45 - 55 | 30 | Masters | Afrikaans |
| Cluster moderator | 35 - 45 | 29 | B.Sc. | IT |

The participants were selected from a diverse range of qualifications and backgrounds. Three participants held doctoral degrees, two held master's degrees, two had undergraduate degrees, and one held a diploma. They were chosen from various areas to provide a more representative sample. Two national moderators/examiners were selected (one from English and one from Afrikaans) to gain their perspectives on the evaluation framework, given the concerns expressed by language teachers during their interactions with the prototype system and their feedback during focus group interviews (see **Section 7.2**). Additionally, two technology teachers (one from middle school and one IT teacher), one IT national moderator and examiner, one subject specialist from an assessment body, one executive manager from an assessment body, and one IT manager were selected to provide their evaluation of the developed framework.

Online interviews were conducted via Teams. All interviews were recorded and transcribed to ensure that an accurate record of each interview was kept and to assist in the subsequent data analysis. The following section reports on the results of the interviews.

## 8.4. Results from the expert interviews

### 8.4.1. The components of an eModeration system

Considering the relevance of the components of an eModeration system, all participants agreed that the user, task, and system components were relevant to the eModeration evaluation framework, as evidenced by the comments *"absolutely; if you look at the structure of the 3-fold system it becomes easy to know from looking at the framework itself what to expect from an eModeration system"* (AB1) and *"Yes, you know you've got to be able to understand how the system works from start to finish astutely"* (NM2).

All participants indicated that they did not see the need for any additional components, with participant AB2 commenting: *"Not necessary, no. I think under each one you can capture all that you try to do."* Further, all participants were in agreement that none of the components should be removed, as the removal of any component would result in an incomplete framework, as highlighted by comments such as *"There are aspects of it which you would have under pre and there's aspects of it which you would have under post but in order to get the big idea about it, you would have to look at it in conjunction"* (AB1) and *"Don't think any of it should be removed, to be honest. If you remove one, I don't think you can carry on with the others"* (IM).

### 8.4.2. Utility

All of the participants agreed that the evaluation framework would effectively assess an eModeration system, as evidenced by the response: *"Yes, I think it is very extensive and I think you've included literally everything that I can think of that I would be able to make an educated decision on whether I would purchase or use the system"* (IT1).

Considering whether the evaluation framework would work in evaluating an eModeration system for use in secondary schools, the majority of the interviewees (87.5%, N = 8) indicated that they believed the framework would serve its purpose as evidenced by the responses, *"I think absolutely"* (AB2) and *"I think it's a very healthy framework .... the factors are very inter-independent because they kind of are able to stand by themselves and be implemented by themselves so it will definitely be able to do what you're looking for it to do"* (NM1). However, one interviewee (12.5%, N = 8) expressed the opinion that the framework's utility may be limited in certain school contexts: *"In some secondary schools, yes because there the context would matter. You know in a secondary school where they have the systems in place and you've been playing around for several years, yes. In an average SA school, no"* (AB2). This finding highlights the importance of considering the context of use when determining the utility of the framework.

With respect to the criteria that could be included to add to the functionality of the evaluation framework, half of the interviewees (50%, N = 8) indicated that they would not include additional functionality, while two interviewees (25%, N = 8) indicated the need to provide visual training. Visual training would capture users' attention and allow them to view training material in their own time.

Additionally, two interviewees (25%, N = 8) indicated concerns around evaluating the security of the eModeration system. These issues are discussed in **Section 8.6.5.3**.

### 8.4.3. Completeness

Most participants (87.5%; N = 8) commented favourably on the level of detail provided by the evaluation framework, indicating that "*I think it is very extensive; it's great"* (IT1). Most interviewees (87.5%) agreed that the framework was complete. An important observation was that it was firstly necessary to have the different levels of components (i.e., the user, task, and system), as each component reflects different aspects of the eModeration system as important within their specific contexts. Secondly, it was necessary to specify exactly what was meant by each criterion to provide a more holistic view of the criteria, as different users would *"have different considerations or requirements"* (AB1). Interviewees also appreciated that the framework was detailed enough to allow a comparison of different eModeration systems so that people could make an *"educated decision on whether to purchase or use a system"* (IT1).

While agreeing with other interviewees that the framework was complete ("*In a nutshell it is beyond complete*"), interviewee AB2 expressed concern that the framework was "*oversubscribed with detail*". This is an important criticism of the framework, which could detract from its use in certain resource-constrained environments. It was therefore necessary to consider what the minimum criteria are, thus underscoring the importance of the context of use.

Two interviewees indicated that they would add the following:

- A visual help functionality;
- Autosave feature so that moderation comments, reports, etc. would not be lost in the event of a power failure; and
- Multiple screens in addition to the split-screen functionality.

It is interesting that national moderators and examiners valued split and multiple screen functionality based on their experiences of moderating exams, whereas the member of the assessment body did not believe that these additional hardware requirements were necessary, instead regarding them as *"nice to have"*. National moderators and examiners clarified that not only did they need to view the questions and the memoranda side by side but, in some instances, they also had to view the Afrikaans and English versions of the question paper and memoranda simultaneously. The context of use thus played an important role in determining which criteria were important.

Two interviewees expressed concern that the framework did not provide for POPIA compliance, as is evidenced by the comment *"I didn't see a lot of mention about security and POPIA and access to information kind of legalities so I think a good system will have included the confidentiality"* (NM1).

#### 8.4.4. Simplicity

All interviewees agreed that the framework was simple to understand and could easily be used by any user within any secondary school environment. Considering how the simplicity of the framework could be improved, interviewees agreed that "*everything can be improved over time"* (NM1). Interviewees agreed that the inclusion of guidelines for each criterion was extremely useful in explaining what the criterion referred to. The results therefore indicate that people preferred the inclusion of guidelines in the form of a checklist, as is evidenced by the comment: *"helps for you to be able to see exactly what criteria we're looking for and to what depth"* (AB1). The inclusion of the guidelines would serve two purposes:

- It would be easy to determine exactly what to look for in an eModeration system; and
- Systems could be compared so that the most feasible system could be acquired based on the organizational context.

Guidelines on the criteria used to evaluate an eModeration system as presented in **Section 8.7** (see **Table 8-6**, **Table 8-7** and **Table 8-8**) is an important practical contribution of this research.

#### 8.4.5. Generality

Many interviewees (N=5; 62.5%) indicated that the open-ended nature of the framework allowed the framework to be easily generalized to work in any educational environment including, but not limited to, home schooling institutions, colleges, universities, the intermediate phases of schooling (Grades four to seven), and the adult education and training sector. Additionally, participants identified examination bodies and any SETA (Sector Education and Training Authority) and assessor courses as domains within which the eModeration framework could be used. NM2 indicated that the framework could be used in any organization where forms, documents, and audits are done, stating that: *"I'm not sure whether it could be used in its entirety."* Thus, different sections of the framework could be used for different organizations depending on their needs, which reinforces the advantage of the open-ended nature of the framework as well as the provision of guidelines. An attempt was therefore made to include a level of granularity in the framework while also ensuring that the minimum criteria were included to suit the needs of different organizations.

The results indicate that the evaluation framework needs to be open-ended to cater for the differing needs, as presented in the following sections.

##### 8.4.5.1. User roles

Depending on the user's role, specific criteria would be viewed as more relevant. For instance, while some teachers and internal moderators preferred to have a voice note functionality, others indicated that they would prefer a live chat facility, as is evidenced by the following comment:

"*I agree that the live chat one might not be as important, but it might be nice to have that*" (NM1). On the other hand, it is mandatory for examiners to provide recorded evidence of any form of collaboration for monitoring purposes. Voice notes would therefore not be a suitable means of communication as this feature does not provide evidence that collaboration occurred, which is important from the point of view of the assessment body.

#### 8.4.5.2. The type of moderation

The user may want to moderate an assessed sample of work or a formal examination paper. The needs differ based on the context. It is therefore necessary for the framework to take cognizance of various usage scenarios. The suggestion was to provide a detailed list of criteria so that individuals could choose those that best suited their needs.

#### 8.4.5.3. Organizational needs

Participant IM indicated that the framework could be generalized to evaluate other custom in-house applications such as social engagement programs, systems capturing sports fixtures, and results and systems used for budgeting purposes within the schooling environment.

It is noteworthy that two national moderators and examiners (NM2, NM3) indicated that the framework could be used for *"quality control"* in terms of the professional development of educators. One of these participants indicated that the eModeration system could be used to evaluate teachers.

Although most of the participants (62.5%, N = 8) agreed that the framework could be generalized to function in the public schooling system, three participants (37.5%) registered some reservations. All three clarified that their reservations arose from a resource point of view in terms of training (*"I do think that with the public schools you probably gonna have greater reticence with buy in I'm not sure if the systems can carry it because it's gonna require a lot of training"(NM2))*, capacity (*"But I don't know if they have the capabilities to actually go through with something like that,. )*, capability *(*"*We have schools who would never be able to use this system. We're gonna do eModeration with them via email and WhatsApp"* (AB2)), and human resources ("*normally at a government school, there's one person that's an executive with the IT manager, he's the secretary and he's doing everything else"* (IM)).

Participant AB2, who is no longer involved in teaching, categorically stated that the framework should be contextualized to the type of school (based on the affluence and demographics of the school) as many schools would not be able to use the framework based on their physical resources, human resources, and general experience of moderation processes.

#### 8.4.5.4. Type of hardware required

Notably, two examiners indicated the need for a split screen functionality and multiple screens to view different versions of examination papers and the memoranda side by side. While participant AB2 indicated that this functionality would be a *"nice to have"*, two national examiners disagreed, commenting that *"for me those kinds of functionalities shouldn't just be dismissed as nice to have ... to have the two side by side is quite important"* (NM1) and *"So, you had split screen, you just need to change that to include multiple screens to be able to see question papers, memos, so you can do a side by side comparison*" (NM3).

Participant NM1 further highlighted the importance of a split screen functionality to avoid security breaches that could arise from printing an examination and also highlighted the negative environmental impact, as is evidenced by the comment: "*it makes your life a lot less complicated because otherwise you end up having to print the paper in any case and that is something that you kind of want to say should not be necessary in the model that you choose at the end of the day*".

### 8.4.6. Clarity

All interviewees agreed that the purpose of all components of the pre- and post-usage criteria were clear, as is evidenced by the comment: *"I don't think there is aspects being used that shouldn't be accessible for the people that are using this system* (NM1). Interviewees reiterated the importance of including an explanation of the criteria, as is evidenced by the following response: "*I need the explanation because if you look at this (criteria) you think what do you mean by this and you look at this (the question) and it answers it"* (NM3).

### 8.4.7. Parsimony

While parsimony and simplicity do not refer to the same concept, they are often used synonymously. For instance, Aarts (2007, p. 2) argues that "Parsimony can be interpreted as simplicity". In discussing parsimony, it was necessary to compare the responses to simplicity, as these criteria are interrelated.

Participants disagreed in terms of the parsimony of the framework. While three indicated that the level of detail was great, two others believed that certain criteria could be *"categorised"* (NM3), and three interviewees indicated that the framework should consist of the minimum criteria that would ensure that the system chosen would be a success, indicating that the additional criteria would only be necessary if one wanted more from the system, as is evidenced by the comment *"it has detail that it does not require"* (AB2).

Interestingly, two of the three interviewees who indicated that the framework could be simplified were not examiners, moderators, or teachers. One was an ICT manager, while the other was a member of the assessment body.

Considering the simplicity of the framework, participant NM3 indicated that they thought certain aspects were being repeated, suggesting that similar aspects could be categorized, as is evidenced by the comment: *"I think the only thing is it looks like you are repeating yourself but it's coming from different aspects that's why I said put it into categories. Because they're close to each other they kind of support each other"* (NM3). On the other hand, when considering the parsimony of the system, the same participant indicated that what appeared as a repetition was in fact necessary, based on the following quote: *"if there is overlap then it's because it is relevant. If someone says no to one criteria, then the other criteria may explain why. So, if you just say yes then the others will also be yes, but if this one's a no then you might have to ask about the other ones to determine why it's a no otherwise, you're not going to have a why, you're just going to have a no"* (NM3).

Participants AB1 and NM3 indicated that criteria could be combined. For instance, the category of communication could include collaboration, instant messaging, and voice notes, as indicated by the following comment: *"If I put it under the umbrella of Communication, the form of* *communication then may be different for different people. So instant messaging is a form of communication. I can communicate in instant messaging but if I don't like to do it in the form of IMs or in whatever other structures that we have, then I could choose to do it in a voice note."* Participant IT2 disagreed, indicating that the level of granularity should be *"open-ended"* as it *"is over-complicating it"* if categories were to be created for different criteria.

Accordingly, some of the criteria were combined (as discussed in **Section 8.6**), while other criteria, such as tracking changes, tracking documents, and tracking deadlines were not combined. The rationale for not combining these criteria was so that there would be a clear indication as to why the eModeration system under consideration was being rejected while ensuring that the framework was thorough. Such information would provide very useful feedback to developers of a system.

All other participants agreed that there were no unnecessary steps included in the eModeration evaluation framework.

### 8.4.8. Usability constructs

All interviewees agreed that they would neither include additional constructs nor exclude any of the identified usability constructs from the initial evaluation framework (**Table 7-2**). Interviewees justified their responses by indicating that the evaluation framework would not be a success as an evaluation tool if constructs were to be removed, as indicated by the following response: "*They suffice. I think you'd lose stuff if you excluded"* (AB2).

All interviewees indicated that the identified constructs were important, as is evidenced by the response: *"you've pinpointed the ones that are the most important"* (NM2). It is noteworthy that interviewees identified efficiency as an important construct, followed by learnability. Two participants identified efficiency as *"key"*, while interviewee (IT1) indicated that "*it being efficient and easy to learn benefits everyone because the teachers will be like ah, this makes my life easy"*.

#### 8.4.9. Hedonic qualities

As with the identified usability constructs, interviewees agreed that they would neither include nor exclude any of the criteria, as is evidenced by the responses: *"This has nothing to do with the system this is just how it made me feel. At the end of the day, do I feel like did it make my life easier. Did it do what I want it to do? Yay, this is what I needed. I wouldn't exclude anything. It covers everything"* (IT1) and *"I think it covers everything from a user perspective"* (AB1).

Consistent with literature findings (e.g., Hassenzahl (2003) and Kashfi et al. (2019)) that hedonic qualities are subjective and moderated by specific usage contexts, it is noteworthy that all interviewees indicated that the hedonic qualities are subjective and that it was difficult to indicate if additional criteria should be included, since a functioning system was needed to make this determination. This finding emphasizes the importance of including both pre- and post-usage criteria in the evaluation framework. Another important finding is that it was necessary to include a level of granularity to allow evaluators to pinpoint exactly where and what issues were.

#### 8.4.10. Improvements to the evaluation framework

Most interviewees agreed that the framework was quite extensive and that they could not think of anything that could be added to create more value.

## 8.5. Thematic analysis of expert interviews

Thematic analysis (TA) (see **Section 5.3.1**), as explained by Clarke and Braun (2013) and Braun and Clarke (2020), was used to analyze the findings due to its characteristics that align with this study, as illustrated in **Table 8-4**.

**Table 8-4: Thematic analysis applicable to expert interview data**

| TA Characteristics | Applicability to study |
|---|---|
| Thematic analysis works well with a variety of research questions (Braun & Clarke, 2006). | An understanding of moderators' and teachers' experiences and understandings of moderation processes in the secondary school context was sought. |
| TA can be used to analyse different types of data (Clarke & Braun, 2013). | It was necessary to analyze transcripts of interviews. |

| TA Characteristics | Applicability to study |
|---|---|
| TA is flexible and works with different-sized data sets (Braun & Clarke, 2006; Clarke & Braun, 2013). | The number of interviewees consisted of a small sample of eight participants. |
| TA can be utilized to create a data-driven or theory-driven analysis (Clarke & Braun, 2013). | A data-driven analysis was used to extract criteria for the evaluation of an eModeration system. |

The code groups that were created in ATLAS.ti® are depicted in **Figure 8-3.** The numbers within brackets indicate the number of themes within each coding group.

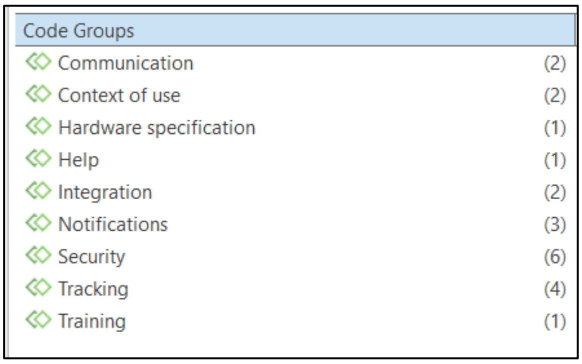



**Figure 8-3: Code groups**

For instance, the themes identified within the security coding group, viz., access to information, authentication method, autosave, compliance with legislation, data storage, and file format are depicted in **Figure 8-4.**

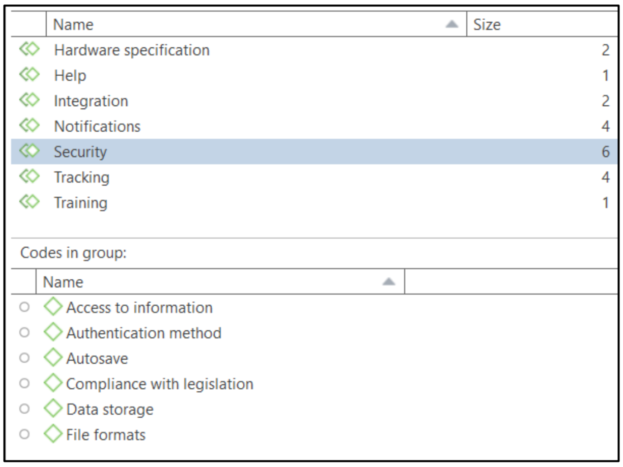


**Figure 8-4: Themes identified within the security coding group**

The transcripts were coded using the coding groups (see **Figure 8-3**) and themes identified as depicted in **Figure 8-5**.

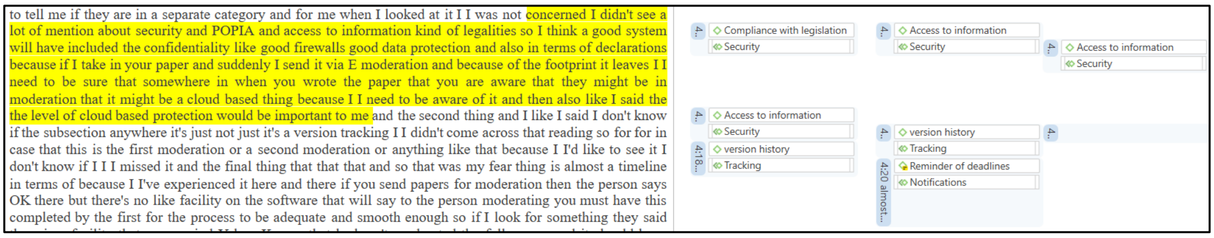



**Figure 8-5: Application of themes to segment of transcript**

The identified themes are discussed in the following section to refine the initial framework.

## 8.6. Refinements to the framework

It is noteworthy that one interviewee suggested that the evaluation framework should consider *"when does your platform fail rather than when does it succeed?"* (AB2). To this end, the evaluation framework was analyzed to determine the essential items that all eModeration systems should have. An analysis of the results highlight the significance of the context of the moderation which, in this thesis, has been categorised as the task context (see **Figure 3-12**).

The refinement of the framework is discussed according to the themes that emerged from coding expert interview data using ATLAS.ti® . The identified themes are communication, context of use, hardware specifications, help, integration with other applications, notifications, security, tracking, and training.

### 8.6.1. Communication

Teachers and moderators wanted the inclusion of communication methods that would enhance the efficiency of the moderation process, indicating that in some instances they simply wanted to leave a quick comment, which would be much easier to do via voice notes and chats instead of having to type it. However, a voice note feature was not practical from the point of view of the assessment body, because there is *"no evidence that you know someone listened to the voice note or read the chat"* (AB2). There is an expectation of accountability from examiners and moderators of national examinations. For instance, while there is no expectation of regional and/or cluster moderators to produce evidence of collaboration, there is an expectation of examiners to collaborate on the platform so that logs are kept as proof of moderation, as is evidenced by the following comment: "*it's all about having the evidence of the process*" (AB2).

While instant feedback and live chat/feedback are not essential for a standard eModeration system, and indeed may not be practical as these features assume that the moderator and the teacher are on the platform at the same time, the context of the moderation would determine the use of specific communication features. For successful collaboration, there must be effective communication. Additionally, based on the context of use, there must be logs to indicate that collaboration has occurred. Therefore, the category communication was created to replace collaboration; and included criteria to keep a log as evidence of all communication as well as to provide various tools via which communication could take place.

### 8.6.2. Context of use

The responses to the interviews highlighted the importance of the context of use. In this section, context of use is discussed specifically in terms of user roles, the type of moderation, the organizational needs, personal preferences, and subject-specific functionality.

#### 8.6.2.1. User roles

The findings indicate that specific users would view certain criteria as more relevant than others, depending on their role in the moderation process. Additionally, depending on the phase of schooling, the assessment body and the nature of assessment being moderated, some criteria would be applicable while others would not. For instance, the IEB uses Subject Assessment Guidelines (SAGs), while the public schooling assessment body uses the Curriculum Assessment Policy statement (CAPs) document. The inclusion of built-in templates would satisfy these different moderation requirements.

The inclusion of multiple roles enables users to log in and perform the requisite functionality, based on their respective roles. Toggle role was therefore incorporated into multiple roles.

#### 8.6.2.2. The type of moderation

Considering that users may teach, moderate, or examine across different subject areas, and may need to moderate multiple tasks within a specific subject area, it was necessary for the framework to take cognizance of the various usage scenarios and the levels of access that users with different roles should have on the platform. Multiple subject integration and multi-user authentication were thus important criteria to retain in the evaluation framework.

#### 8.6.2.3. Organizational needs

Two recommendations were made regarding the applicability of the framework to different types of organizations:

- The framework should focus on the minimum requirements necessary to procure an effective eModeration system; and
- The framework should be designed to evaluate a basic eModeration system that could be used at all secondary schools, irrespective of their resources.

The need to provide minimum requirements and a focus on the framework's applicability to resource-constrained environments was acknowledged by removing some of the criteria during refinement of the framework.

#### 8.6.2.4. Personal preferences

It is noteworthy that Participant IM, speaking purely from a development point of view, indicated that it would be a *"headache"* to allow users the functionality to change fonts, sizes, and others, as these would have an impact on the design and the possible functioning of the system. However, with consideration of the following aspects:

- A need for the system to be accessible to different types of users;
- The importance of customizing the screens based on user preference for teachers and moderators who would be using the eModeration system on a regular basis; and
- If there is no buy-in from teachers and moderators, the system will not be utilized,

personal preferences were deemed to be important for inclusion in the evaluation framework and were included as user preferences in the post-usage criteria of the user component.

#### 8.6.2.5. Subject specific functionality

Considering the subject-specific functionality, one language moderator recommended the inclusion of a standardized way of commenting. The specific issue was that teachers' application of conventions were not consistent. The suggestion was to include a reminder, for example: *"use these symbols to indicate ...do not upload if you haven't done it this way" (NM1).* After further discussion, it was agreed that this functionality was subject-specific. A standardized way of commenting (which was specifically a requirement for Afrikaans assessments) was not something to be *"regulated"* (NM1) by the eModeration system. Furthermore, considering that the framework included *"annotation tools providing subject-specific tools"* and *"it is up to the teacher to implement it correctly"* (NM1*),* the suggestion to include a standardized method by which moderators could comment on assessments was not implemented.

### 8.6.3. Hardware specifications

The hardware specifications are discussed in terms of the output quality, the need for multiple screens, platform independence, and aesthetics.

#### 8.6.3.1. Output quality

While the output quality of an ICT system is important, it is understood to form the basis of any general ICT system. In the context of an eModeration system, the moderation will not be an automated process. While the system's output quality is by no means irrelevant, it is outside the scope of the requirements of an eModeration system. Thus, output quality was removed from the framework as a criterion to evaluate an eModeration system.

#### 8.6.3.2. Multiple screens

The findings indicate that national examiners and moderators of external examinations specifically required multiple screens and a split screen functionality to allow for easy viewing of various versions of examination papers and memoranda.

A related issue was that of printing a paper, as is evidenced by the following comment: *"as soon as you allow people to print, breach becomes higher"* (NM3). The provisioning of multiple and split screen functionalities eliminates the need to print various versions of the examination papers and memoranda, which decreases the probability of compromising the integrity of the examination. The possible security breach arising from printing underscores the importance of a dedicated eModeration system which, based on its core purpose, should eliminate the need for hard copies.

#### 8.6.3.3. Platform independence

To ensure that the eModeration system is truly platform-independent, a suggestion was made to include iPads to the list of other devices that had been catered for when providing guidelines for the criteria.

#### 8.6.3.4. Aesthetics

It is significant that the two language examiners and moderators specifically mentioned the visual appeal of the system albeit from differing, but valid points of view. While NM2 indicated that *"if you're gonna make it look very pretty with graphics and whatever it's just gonna slow down the whole damn process; so it's a very careful balance ..." ,* NM1 commented that *"You kind of want things to be a little prettier, not just the functionality, so for me it would be an important thing, that it is a well-rounded product"*, given that many of the focus group participants acknowledged that aesthetics was important to them, and cognizant of participant NM2's comment that "*it's a very careful balance*", aesthetics was retained in the evaluation framework.

#### 8.6.3.5. Help

All interviewees agreed that the help functionality is an imperative in any eModeration system, as inexperienced teachers would most likely require some form of assistance when starting to use the system. In light of the suggestions for provisioning of online and video help functionalities, a decision was taken to remove technical support as a criterion and retain functional help.

### 8.6.4. Integration with other applications

The findings indicate that it is necessary to integrate the eModeration system to other applications to enhance its functionally. Integration with other applications is discussed in terms of integration with cloud storage and integration with the Learning Management System (LMS) used by the institution.

#### 8.6.4.1. Integration with cloud storage

The integration with cloud storage depends on the nature and purpose of the moderation. For instance, if the assessment is a national examination paper that is being controlled by the examining body, then access to cloud storage should be disabled to protect the integrity of the assessment. On the other hand, if the moderation is internal or the cluster moderation of school-based assessment, then access to cloud storage becomes a requirement. A member of the national assessment body raised the integration of cloud storage as a security issue, despite indicating that cloud-based storage was the only way to transfer large files for external validation by regulatory bodies. It was necessary to retain this functionality as the different types of moderation and accountability processes required the use of cloud-based storage for their efficacy.

#### 8.6.4.2. Integration with cluster manager

As with cloud storage, the integration with the cluster manager of the assessment body was also raised, both as a security issue and as a POPIA (see **Section 8.6.5.6.)** requirement. Additionally, different organizations make use of different LMSs based on their financial and security requirements. The criterion *Integration with Google Classroom/Cluster Manager* was therefore adapted to *Integration with LMS* for the purpose of uploading batches from the Learning Management System (LMS) is being used by the specific institution to generalize the use of the framework.

### 8.6.5. Notifications

Notifications are discussed in terms of the reminders of deadlines and notifications of the moderation progress.

#### 8.6.5.1. Reminders of deadlines

While one individual indicated that they did not need to be notified of deadlines, all of the others indicated that this was an important functionality. Considering empirical evidence of the lack of time (see **Section 6.6.3**), anecdotal evidence emphasized the importance of moderators being prompted about looming deadlines. Therefore, reminders of deadlines were included as a system criterion.

#### 8.6.5.2. Notifications of moderation progress

Two external examiners indicated that they would like to see a timeline of the moderation progress. A timeline would provide a visual view of the moderation progress, together with the ability to view intermediate deadlines at a glance. Tracking of deadlines was thus retained in its original form without prescribing exactly how this provision should be made so that the framework can be generalized.

A general notifications criterion was included in the evaluation framework to provide alerts of communications, teacher uploads of files, and others, so that users could tailor the notifications to suit their personal preferences. For instance, as an examiner it would be extremely important to obtain notifications in real-time.

#### 8.6.5.3. Security

The inclusion of security is presented in terms of access to information, the authentication method used, compliance with legislation, downloading of files, the protection of files, and file formats allowed.

#### 8.6.5.4. Access to information

Depending on the role of the user, certain levels of access need to be provided. For instance, if the user is a teacher uploading an assessment, the teacher would need the facility to log in, upload the assessment, and access the moderator report. On the other hand, the moderator would need to be able to log in, access the uploaded document, annotate the document, and access the database of comments to produce a report. The moderator should not be able to access the assessments of schools that had not been assigned to them, nor should teachers be able to access the documents of other schools. The level of access based on the role of the user becomes especially important if the assessment is an examination. It is therefore necessary to ensure that users have the necessary access permissions based on their specific roles.

#### 8.6.5.5. Authentication method

An analysis of the data indicated the need for two-factor authentication to be included in the evaluation framework for added security. The addition of this criterion was informed by the participants' mention thereof at the PD workshops. Two-factor authentication was not included in the initial evaluation framework, since it was not raised during the survey and the focus group interviews. A possible reason for this is the demographics of the participants. The initial PD workshops were conducted amongst IT examiners, sub-examiners, and moderators, while the focus group interviews were conducted amongst teachers of different faculties in one private secondary school. The demographics of the participants played a role in the criteria identified, highlighting the significance of considering the context of use. Despite security being a commonly mentioned concern, specific details on the type of security to be implemented were limited due to the scarcity of literature on eModeration systems. Participant IM expressed concern about the security measures for data storage and access, as is evidenced by the following comment: *"The security ... not the security of the application, where the data is housed, who's got access to the data, that type of thing"* (IM) and suggested that *"So from my side, I would add something like two-factor authentication"* (IM).

#### 8.6.5.6. Compliance with legislation

The Protection of Personal Information Act (POPIA) is an act of parliament that is applicable to all entities that collect and process personal information. The act prescribes the requirements for the collection and processing of personal information to protect it from any form of unlawful processing (ISASA, 2021).

Compliance with legislation requires that the protection of personal information be taken into consideration. The omission of how data would be processed by the eModeration system necessitated two important changes to the evaluation framework. The criteria presented in the following section were thus added to the pre- and post-usage task criteria.

#### 8.6.5.6.1. POPIA compliance

The purpose of the inclusion of POPIA compliance was to ensure that the eModeration system would indicate POPIA compliance when the user signs up for the first time. The system would provide a read me document indicating which user data is being stored, where user data is being stored, how the privacy of the data will be maintained, how long the data will be kept for, and how the user can determine which data about them is being stored.

#### 8.6.5.6.2. Data storage

The analysis of data revealed three important considerations with respect to compliance with legislation regarding data storage. First, it was imperative to clearly specify the location, manner, and duration of data storage. Secondly, stakeholders needed to be able to access information about which data was being stored. Lastly, measures had to be put in place to secure the stored data and ensure its protection. Data storage was thus added to the pre- and post-usage system criteria with the objective of answering the following questions:

- Does the system include features to ensure POPIA compliance?
- Does the system allow the user to access the information that has been stored about them?
- Will the system allow the user to update the information stored about them?

#### 8.6.5.7. Downloading files to work offline

The IT manager and the examiners held divergent views with regards to the downloading of files. The IT manager proposed the elimination of offline functionality, claiming that working offline in a collaborative environment could lead to data corruption or multiple versions of the same file. On the other hand, the examiners favoured the ability to moderate offline, proposing the inclusion of a pop-up reminder to delete the file from the downloads folder. While both perspectives took security into consideration, after considering the following key factors, a decision was taken to retain the ability for moderators to download files so that they could work offline and thereafter upload the moderated documents:

- The moderation of external examinations relies largely on the integrity of the individuals involved in the process;

- In the context of moderating a task, only one person would be working on the document at any given time; and
- The examiner, as the person who would be utilizing the system, would be the person most affected by the efficiency of the process.

To mitigate security concerns and maintain the integrity of the assessment process, the recommendation to incorporate a pop-up window (NM1) that reminds the user to delete the document from their downloads folder was implemented within the evaluation framework.

#### 8.6.5.8. Protection of files

An important issue was functionality to ensure that moderators would not lose changes made in the event of a loss of connectivity or power. As the initial framework lacked provisions to address this, an autosave functionality was added to the task criteria to guarantee that moderated documents would not be lost.

#### 8.6.5.9. File formats

A suggestion was made to permit users to upload various file types, as a moderator may need to provide alternative documents, for instance: *"if you're not happy with an image then you can find another image ...; so am I able to upload that as a separate document"* (AB1). However, the IT manager argued for limiting the file types to PDF or Word documents for security reasons, to prevent the uploading of harmful files to the server. Weighing the benefits of increased flexibility versus the potential risks to security in the guidelines were amended to: *Does the eModeration system enable the uploading of files of different file types that do not compromise security?*

### 8.6.6. Tracking

Repeated comments regarding the need to provide proof of moderation underscore the importance of tracking. Tracking is discussed in terms of providing evidence of moderation via version histories, the tracking of changes, and the tracking of documents.

#### 8.6.6.1. Version history

All participants agreed that a version history or audit trail was necessary to track changes made to documents, including the user who made the changes and the date of modification. The audit trail would establish the evidence of moderation and enable stakeholders to monitor progress and review versions, especially when multiple documents are linked to one assessment. Additionally, the version history could aid in resolving errors and serve as a tool for professional development by allowing examiners to assess their performance based on the number of versions created each year.

#### 8.6.6.2. Tracking of changes

The tracking of changes is an important element in any eModeration system. Not only does it provide proof of moderation, but it also makes it easier for the person who has created the assessment to determine if they want to accept or reject the change.

#### 8.6.6.3. Tracking documents

An organized file structure enables stakeholders to easily keep track of the different versions of documents related to specific assessments so that it is easy to find the necessary files. The ability to track all documents improves efficiency.

### 8.6.7. Training

Interviewee responses prompted the integration of a visual training approach. The rationale for this came from participants' experiences of training. Participants indicated that visual training, such as videos, made it easier to understand the content and facilitated more targeted questions during face-to-face training sessions. Additionally, the extant literature indicates that when performance is high, the user satisfaction is also high (Islam, 2014). This finding points to the importance of training in increasing user satisfaction levels when using an IS.

## 8.7. Refined evaluation framework

Considering comments regarding the minimum success criteria and the inclusion of user experience criteria, the refined evaluation framework consisted of core functionality criteria and value-added criteria to ensure an effective and efficient eModeration system with a positive user experience. The core criteria included minimum success criteria, and the value-added criteria included pre-and post-usage criteria for improved user experience. The refined framework is depicted in **Table 8-5**. The amended and/or additional criteria are indicated in red.

**Table 8-5: Refined evaluation framework**

| | | |
|---|---|---|
| **User** | **Pre- and post-usage criteria** | |
| | User preferences | |
| | **Post-usage criteria** | |
| | Ease of learning | User effectiveness |
| | Self-efficacy | User efficiency |
| | Training and experience | **User preferences** |
| | Usefulness | User satisfaction |
| **Task** | **Pre- and post-usage criteria** | |
| | Annotation tools | Multiple roles |
| | Audit trail | Multiple subject integration |
| | Automatic updates | Multi-user authentication |
| | **Autosave** | Notifications |
| | Built in templates | Online editing |
| | Calendar | Organized file structure |
| | **Communication** | **POPIA compliance** |
| | Database of comments | Shortcut keys |
| | Environmentally friendly | Tracking changes |
| | Functional help | Tracking deadlines |
| | Instant feedback | Tracking documents |
| | Live chat/feedback | Versioning |
| | **Post-usage criteria** | |
| | Split screen | **Pop up window** |
| **System** | **Pre- and post-usage criteria** | |
| | Accessibility | Platform independent |
| | Centralized data storage | Reliability |
| | Cross platform | Reminders of deadlines |
| | **Data storage** | Reporting |
| | File formats | Security **(Two-factor authentication)** |
| | Integration with cloud storage | Synchronization |
| | Integration with **LMS** | |
| | **Post-usage criteria** | |
| | Aesthetics | Internet connectivity |
| | Dependability | Web-based |

The finding that interviewees valued the inclusion of guidelines in the form of a checklist led to the formulation of pre- and post-user, task, and system guidelines as part of the refined evaluation framework. The guidelines were formulated to help users understand the framework, evaluate, and compare different eModeration systems, and obtain management buy-in for budgeting purposes. The guidelines were decomposed into user, task, and system components to provide a comprehensive evaluation tool (see **Table 8-6, Table 8-7** and **Table 8-8**) for ease of access. Criteria and descriptors that were amended and/or included are indicated in red and appear in bold.

**Table 8-6: Pre- and post-usage user guidelines**

| | **Pre- and post-usage criteria** | **Guidelines** |
|---|---|---|
| **User** | User preferences | Will the user be able to change the colours, fonts, and size of fonts of the different screens according to their personal preferences?<br>Can users choose specific icons or tools based on their subject-specific requirements?<br>Will the user be able to modify the login page to include items such as the school logo? |
| | **Post-usage criteria** | **Guidelines** |
| | Ease of learning | Is it simple to understand and learn how to use the eModeration system? |
| | Self-efficacy | Does the successful integration of the eModeration system boost users' confidence in the use of the eModeration system? |
| | Training and experience | Will the eModeration system be perceived positively once users have had training on its use?<br>Will video tutorials be provided for teachers to watch in their own time?<br>Will training on the use of the eModeration system strengthen the user's motivation to use the system? |
| | Usefulness | Does the eModeration system satisfy the users' needs and expectations and make it easier to achieve their goals? |
| | User effectiveness | Can users successfully use the eModeration system to complete the moderation effectively? |
| | User efficiency | Does the eModeration system enable the user to complete the moderation with minimal effort?<br>Does the eModeration system respond quickly to user inputs? |
| | User preferences | Can the user change the colours, fonts, and size of fonts of the different screens according to their personal preferences?<br>Can users choose specific icons or tools based on their subject-specific requirements?<br>Can the user modify the login page to include items such as the school logo? |
| | User satisfaction | Does the use of the eModeration system contribute to a positive user experience? |

**Table 8-7: Pre- and post-usage task guidelines**

| | Pre- and post-usage criteria | Guidelines |
|---|---|---|
| Task | Annotation tools | Are annotation tools provided?<br>Do the annotation tools provide the functionality to place ticks and crosses?<br>Do the annotation tools provide subject-specific functionality?<br>Are specific stamping tools provided to allow the user to easily add specific annotations? |
| | Audit trail | Does the eModeration system provide a history of the documents created, and by whom and when changes were made?<br>Can the teacher view different versions of the moderated documents? |
| | Automatic updates | Does the eModeration system allow documents to be automatically updated across all devices? |
| | Autosave | Does the eModeration system provide the functionality for documents to be automatically saved as the user is working on the document? |
| | Built in templates | Does the eModeration system provide access to built-in templates that the moderator can populate? |
| | Calendar | Does the eModeration system contain a calendar to view upcoming tasks? |
| | Communication | Will the eModeration system facilitate collaboration amongst teachers and moderators?<br>Will the eModeration system provide a log of all communication between teacher and moderator?<br>Will the eModeration system provide the tools for different forms of communication, such as:<br>➢ Voice notes<br>➢ Instant messaging<br>➢ Notifications |
| | Database of comments | Will the eModeration system provide prewritten comments from which the moderator can select? |
| | Environmentally friendly | Does the use of the eModeration system reduce negative effects on the environment?<br>Does the use of the eModeration system reduce the amount of consumables used? |
| | Functional help | Does the eModeration system provide a help facility to support users' needs?<br>Is the help functionality provided in a visual format for users to view?<br>Can online help be accessed via user-initiated requests?<br>Does the online help provide specific information for teachers and moderators to use the eModeration system with ease? |
| | Multiple roles | Will the eModeration system allow the user to select the role of teacher or moderator?<br>Will the eModeration system be able to adapt to different roles?<br>Will the eModeration system cater for different levels of users? |

| | | |
|---|---|---|
| | Multiple subject integration | Can the eModeration system be used by users from different subject areas? |
| | Multi-user authentication | Does the eModeration system enable multiple users to log in?<br>Can the eModeration system authenticate several users? |
| | Notifications | Does the eModeration system provide notifications when files have been uploaded for moderation?<br>Does the eModeration system provide notifications when the moderation has been completed?<br>Does the eModeration system provide notifications of deadlines when moderation needs to be completed? |
| | Online editing | Does the eModeration system make provision for the user to edit documents online? |
| | Organized file structure | Does the eModeration system provide the facility for the teacher and moderator to create an organized file structure to store their documents? |
| | POPIA compliance | Will the system provide a message indicating POPIA compliance when the user signs up for the first time?<br>Will the system provide a read me document indicating:<br>➢ What user data is being stored.<br>➢ Where user data is being stored.<br>➢ How privacy of the data will be maintained.<br>➢ How long the data will be kept for.<br>➢ How the user can determine what data about them is being stored. |
| | Tracking changes | Does the eModeration system allow the user to view changes made to a document? |
| | Tracking deadlines | Will the user of the eModeration system be able to track the moderation progress? |
| | Tracking documents | Will the user be able to easily find the requisite files and documents for moderation? |
| | Versioning | Will the eModeration system enable the user to view a history of changes of all documents?<br>Can the user revert to a previous version of a document? |
| | **Post-usage criteria** | **Guidelines** |
| | Split screen | Does the eModeration system provide a split screen functionality so that documents can be viewed side by side? |

## Table 8-8: Pre- and post-usage system guidelines

| | Pre- and post-usage criteria | Guidelines |
|---|---|---|
| System | Accessibility | Will the design of the eModeration system allow users who are visually impaired to easily access the system?<br>Will users of varying capabilities be able to access the system with ease? |
| | Centralized data storage | Does the eModeration system provide a centralized location for the storage of moderated documents?<br>Can all relevant documentation be found at a centralized location? |
| | Cross platform | Will teachers and moderators be able to access the eModeration system from any operating system platform? |
| | Data storage | Does the system include features to ensure POPIA compliance?<br>Does this system allow the user to access the information that has been stored about them?<br>Will the system allow the user to update the information stored about them? |
| | File formats | Does the eModeration system enable the uploading of files of different file types **that do not compromise the security of the system?**<br>Does the eModeration system allow the user to download files of different file types? |
| | Integration with cloud storage | Does the eModeration system allow data to be stored and accessed via cloud storage?<br>Does the cloud storage system prevent access from outside South Africa? |
| | Integration with **LMS** | Will the eModeration system allow moderation batches to be uploaded from learning management systems?<br>Will the eModeration system integrate with other systems? |
| | Platform independent | Will the user be able to use the eModeration system using laptops?<br>Will the user be able to use the eModeration system using tablets **and/or iPads**?<br>Will the user be able to use the eModeration system using desktops? |
| | Reliability | Are the services provided by the eModeration system dependable?<br>Does the eModeration system include information about **where data is housed and about a backup plan?** |
| | Reminders of deadlines | Will the eModeration system provide reminders of deadlines for the uploading of moderation batches?<br>Does the eModeration system provide reminders to moderators when moderation documents are due? |
| | Reporting | Does the eModeration system provide a reporting functionality for the moderator to generate a report of the moderation?<br>Does the eModeration system enable users to access reports timeously? |
| | Security | Does the eModeration system protect information and data from unauthorized access? |

| | | |
|---|---|---|
| | | Does the eModeration system provide the degree of data access appropriate to users' levels of authorization?<br>Will the eModeration system provide two-factor authentication?<br>Is there a pop-up window to remind the user to delete any confidential documents from the downloads folder? |
| | Synchronization | Will changes made to documents be synchronized across all the user's devices? |
| | Web-based | Can the eModeration system be accessed online?<br>Will the user be able to download a document to **work offline?**<br>Will the eModeration system be compatible with different types of web browsers? |
| | **Post-usage criteria** | **Guidelines** |
| | Aesthetics | Does the visual impact of the user interface elicit positive emotions in the user?<br>Does the use of graphical elements and colours on the eModeration system evoke positive emotions in the user?<br>Does the user have the impression that the eModeration system looks appealing? |
| | Dependability | Does the eModeration system respond consistently to user inputs?<br>Does the user feel that they control the interaction with the eModeration system? |
| | Internet connectivity | Does the network infrastructure support the use of the eModeration system? |
| | Multiple screens | Does the system configuration provide for the connection of multiple screens? |

## 8.8. Conclusion

This chapter presented an initial evaluation framework for an eModeration system. Criteria for the evaluation of a framework were extrapolated from the extant literature (see **Table 8-5**). The criteria provided a basis for structuring interview questions around the validity of the evaluation framework. Eight expert participants were purposefully selected to provide their input on the evaluation framework. The responses were analyzed using Braun and Clarke's (2006) thematic analysis. The initial criteria for the evaluation of an eModeration system were refined further to provide core criteria necessary to evaluate the success of an eModeration system and to measure the user experience of the eModeration system by proposing pre- and post-evaluation criteria. Notably, pre- and post-usage user (**Table 8-6**), task (**Table 8-7**) and system (**Table 8-8**) guidelines were developed. The following chapter presents a conclusion to this thesis by combining the different strands of information to indicate how the research questions were answered.

# Chapter 9: Conclusion

## 9.1. Introduction

Chapter Eight presented a synthesis of data obtained from expert interviews on the evaluation of the eModeration evaluation framework. The analysis of the insights gleaned from interviews with domain experts was used to provide a validation of the eModeration evaluation framework (**Table 8-5**) together with guidelines for its use (**Table 8-6**, **Table 8-7** and **Table 8-8**).

The objective of this concluding chapter is to present a critical review of the study. This is done by first evaluating key decisions concerning the research and outputs in relation to proposed DSR guidelines for relevance and rigor (Hevner & Chatterjee, 2010). Secondly, the research contributions are mapped to Gregor and Hevner's (2013) DSR Knowledge Contribution Framework to demonstrate the impact of this study. The impact of the contribution is substantiated by mapping the maturity of the solution to the application domain (Gregor & Hevner, 2013). This chapter is organised as follows:

This chapter is positioned within the rigor cycle of the DSR process. **Section 9.2** presents an overview of the research. **Section 9.3** presents evidence of how the research questions were answered, outlines where in this study these research questions were addressed, and describes the research outcomes. **Section 9.4**. presents the purpose of the framework. **Section 9.5** presents a summary of the research design. **Section 9.6** presents a reflection on the key findings. **Section 9.7** discusses the key contributions of this study. **Section 9.8** presents the limitations of this study. **Section 9.9** proposes areas for future research. **Section 9.10** offers a personal reflection on the insights gained and the personal growth that occurred during the process of compiling this research. This chapter is concluded in **Section 9.11** by proposing areas for future research, recording the limitations, and outlining the overall conclusions from this thesis.

## 9.2. Research overview

The research problem articulated in this study was informed by literature findings that indicate that the moderation of assessments is largely grounded in traditional paper-based methods (Van Staden et al., 2017), despite the increasing use of ICTs in the management of assessments

(Vergés Bausili, 2018). A lack of theorization on eModeration, together with a dearth of empirical evidence of the use of eModeration systems in secondary schools, provided the rationale for this study on evaluating the user experience of an eModeration system. Against the background of rapidly changing assessment strategies and the increasing use of ICTs in assessments, this study argued for a shift from traditional, paper-based moderation processes towards digital moderation.

To achieve this objective, it was first necessary to examine the extant literature for information on eModeration systems. A systematic literature review of eModeration was conducted to determine what systems currently exist for digital moderation (see **Section 2.5.1.5**) and to determine what the components of an eModeration system are (see **Table 2-9**). Secondly, Technology Acceptance Models, IS Success models, and the field of HCI were investigated to determine what the criteria of an eModeration evaluation framework are (see **Table 3-9**).

This section presents the gaps identified in the literature and indicates the measures to address these gaps.

### 9.2.1. Evidence of eModeration systems

The first gap identified by this study is that there is no evidence of dedicated eModeration systems in the SA secondary school environment. There are not many references to the use of eModeration systems, nor the requirements for the design of an eModeration system in the extant body of knowledge. This research filled this gap by combining a systematic literature review with a PD data capturing strategy to determine context-specific requirements for an eModeration system.

### 9.2.2. Evaluation of eModeration systems

The second gap identified was a lack of evidenced-based criteria for the evaluation of eModeration systems. This gap was addressed by using a participatory design approach to gather requirements from teachers who are involved in the moderation process. A theoretical framework was introduced to provide a basis for data analysis and interpretation. The development of an eModeration prototype allowed for in-situ evaluation of the system. The criteria extrapolated from different data collection methods were used to design the eModeration evaluation framework that can be used to evaluate eModeration systems.

#### 9.2.3. Criteria to evaluate the UX of an eModeration system

The third gap identified relates to a lack of evidence of criteria to use in the evaluation of the UX of an eModeration system. Additionally, apart from the work of Van Staden (2017) that was in the context of HEIs, no evidence could be found of guidelines to evaluate an eModeration system. This gap was addressed by developing a framework detailing the components of an eModeration system and the criteria to be used in the pre- and post-implementation evaluation of an eModeration system. The development and evaluation of the context-specific criteria necessary to evaluate a potential or existing eModeration system resulted in a validated eModeration evaluation framework.

## 9.3. Answering of research questions

Hevner and Chatterjee (2010) presented a table towards guiding the evaluation of DSR research. These guidelines are presented in **Table 9-1** to delineate this research. The questions from Hevner and Chatterjee (2010) are mapped to the research questions presented in this study. The main research question is presented as Main RQ, with the sub-questions presented as RQ1, RQ2, and RQ3 respectively. **Table 9-1** presents a summary of how the research questions were answered in terms of the research activity conducted, where in the study the research question was addressed, what the research outcome was, and what the overall findings were.

**Table 9-1: Answering of research questions**

| Questions for DSR research (Hevner & Chatterjee, 2010) | Thesis research question | Research activity | Addressed in | Research outcome | Findings |
|---|---|---|---|---|---|
| What is the research question?<br>What is the artefact?<br>How is the artefact represented? | **Main RQ:** What are the components of a user experience evaluation framework for electronic moderation systems for secondary schools? | PD workshops<br>Survey<br>Focus group interviews<br>Expert interviews | Chapter Seven –<br>Chapter Eight - | Validated eModeration evaluation framework. | **Table 8-5** |
| What design processes (search heuristics) will be used to build the artefact? | **RQ1:** What are the components of an eModeration system? | Literature review | Chapter Two | User, task, and system. | **Table 2-9** |
| How are the artefact and the design processes grounded by the knowledge base? What, if any, theories support the artefact design and the design process? | **RQ2:** What are the criteria that can be used to evaluate the user experience of an eModeration system? | Iteration one: Literature review Part 1<br>Iteration two: Literature review Part 2 | Chapter Two; Table 2-9 (initial criteria) – Iteration 1<br>Chapter Three; Table 3-9 (refined criteria) – Iteration 2 | Theoretical framework: usability and UX constructs pertinent to the evaluation of an eModeration system.<br>Refined eModeration criteria mapped onto eModeration system components from RQ one. | **Table 7-2** |
| What evaluations are performed during the internal design cycles? What design improvements are identified during each design cycle? | **RQ3:** How can independent secondary school teachers contribute to the design and validation of a user experience evaluation framework for an eModeration system? | PD workshops<br>Survey<br>Focus group interviews | Chapter Five: Data captured during PD workshops.<br>Chapter Six: Analysis of data from PD workshops. | Chapter Six – adapted questionnaire<br>Chapter Seven<br>Chapter Eight | |
| How is the artefact introduced into the application environment and how is it field tested? What metrics are used to demonstrate artefact utility and improvement over previous artefacts? | | Expert interviews | | Chapter Eight – refined evaluation framework. | |
| What new knowledge is added to the knowledge base and in what form (e.g., | | Thematic analysis of | Chapter eight | Refined evaluation framework. | |

| Questions for DSR research (Hevner & Chatterjee, 2010) | Thesis research question | Research activity | Addressed in | Research outcome | Findings |
|---|---|---|---|---|---|
| peer-reviewed literature, meta-artefacts, new theory, new method)? | | expert interviews | | | |
| Has the research question been satisfactorily addressed? | | | | Validated eModeration evaluation framework<br>Pre- and post-usage guidelines | **Table 8-6**<br>**Table 8-7**<br>**Table 8-8** |

## 9.4. Purpose of framework

The purpose of the framework for the evaluation of an eModeration system, as presented in Chapter Eight (see **Table 8-5**), is to guide planning efforts during the development and implementation of eModeration innovations in the secondary school environment. To this end, the framework will be used to:

- Provide guidance on purchasing proprietary eModeration systems including an evaluation of the developed eModeration system, i.e., providing both pre-usage and post-usage criteria;
- Evaluate eModeration system requirements when school management wants to evaluate an existing commercial system for purchase (post-usage); and
- Ensure that the eModeration system meets the needs of the stakeholders involved in the secondary school environment.

## 9.5. Research design summary

A DSR research design underpinned a Participatory Design data collection strategy which was iterated within a Participatory Action Design Research (PADRE) approach. A Thematic Analysis model was used to identify, analyze, and report on themes within the open-ended responses from teachers and moderators so that the data could be explored in depth.

DSR as a research design adopted in this study is based on the Four-Cycle View of DSR (see **Figure 4-1**), presented by Drechsler and Hevner (2016), and the Design Science Research Process Model (DSRPM) proposed by Vaishnavi et al. (2017), as illustrated in **Figure 4-2**.

The research process of this study, demarcated by the phases, inputs, activities, and outputs underpinned by a PADRE approach within the DSR cycles, is depicted in **Table 9-2**.

**Table 9-2: Research process demarcated by the phases, inputs, processes and outputs**

| PHASE | INPUT | PROCESS | OUTPUT |
|---|---|---|---|
| PHASE 1<br>**DSR:** Change and Impact Cycle<br>**PADRE:** Problem formulation | Literature: Theories, identification of problem, and motivation of relevance. | Preliminary literature review. Formulation of research problem, identification of research questions, and motivation for relevance of study. | **Chapter One:** Introduction and rationale for study, identification of gaps, and motivation for relevance of study. Research flow process (**Figure 1-4**); Roadmap of thesis layout (**Figure 1-5**). |
| | Information from Chapter One. | Systematic literature review. Identification of:<br>➢ Existing moderation systems;<br>➢ Requirements of an eModeration system;<br>➢ Components of an eModeration system; and<br>➢ UX constructs. | **Chapter Two:**<br>Components of an eModeration system (**Table 2-9**).<br>Criteria for evaluating an eModeration system (**Table 2-9**) |
| PHASE 2<br>**DSR:** Relevance Cycle<br>**PADRE**: Problem formulation | Information from Chapter Two. | Literature review. Comparison of Technology Acceptance Models, IS Success Models, HCI.<br>Existing UX frameworks.<br>Usability constructs pertinent to an eModeration system.<br>Components of an eModeration system.<br>UX constructs to evaluate an eModeration system. | **Chapter Three:**<br>Technology Acceptance Models<br>HCI<br>IS Success Models<br>UX constructs for evaluating an eModeration system<br>Theoretical framework (see **Figure 3-14**). |
| PHASE 3<br>**DSR:** Design Cycle<br>**PADRE:** Building, intervention, and evaluation | Information from Chapters One to Three.<br>Literature review: Research design, paradigms, methodology, data capturing. | Design and develop research methodology. | **Chapter Four:** Research design and methodology of how the study was designed.<br>➢ Mapping of PADRE to DSR (**Figure 4-4**).<br>➢ Operationalization of research questions (**Table 4-4**). |
| | Prototype Version 1 based on requirements extracted from literature. | **Intervention:** Participatory Design workshops – requirements gathering and design ideas. | Requirements for eModeration system.<br>Design ideas for developing an eModeration system. |
| | Requirements for eModeration system.<br>Design ideas for developing an eModeration system. | **Intervention:** Analysis of requirements and design ideas from PD workshops.<br>**Building:** Prototype Version 2<br>**Evaluation:** Criteria from PD workshops compared to literature review. | **Chapter Five:**<br>➢ Prototype eModeration system (see **Appendix D**).<br>➢ Tabulated comparison of UX criteria from PD workshops and literature (Table 5-7. |
| | Prototype eModeration system. | **Intervention:** Teacher interaction with prototype.<br>**Building:** Development of questionnaire. | Online survey responses. |

| PHASE | INPUT | PROCESS | OUTPUT |
|---|---|---|---|
| | | **Intervention:** Online survey. | |
| | Online survey Responses. | **Evaluation:**<br>Analysis of data collected from online survey. | Findings from online survey. |
| | Findings from online Survey. | **Building:** Development of focus group interview questions.<br>**Intervention:** Focus group interviews.<br>**Evaluate:**<br>➢ Analysis of data from focus group interviews; and<br>➢ Data triangulation. | **Chapter Six:** Quantitative and qualitative results from a triangulation of online survey and focus group interviews. |
| | **Chapter Six:** Findings from a triangulation of survey and focus group interviews. | **Evaluate:** Comparison of criteria from literature review, PD workshops, online survey, and focus group interviews. | **Chapter Seven:** Initial eModeration evaluation framework consisting of pre-and post-usage criteria for evaluating an eModeration system (**Table 7-2**). |
| | **Chapter Seven:** Initial eModeration evaluation framework. Pre-and post-usage criteria for evaluating an eModeration system. | **Building:**<br>➢ Criteria for evaluating framework.<br>➢ Development of interview questions based on criteria.<br>**Intervention:** Expert interviews.<br>**Evaluation:** Thematic analysis of responses from expert interviews. | **Chapter Eight:**<br>➢ UX eModeration evaluation framework (**Table 8-5**).<br>➢ Guidelines for evaluating an eModeration system based on user, system and task (**Table 8-6**, **Table 8-7**, **Table 8-8**). |
| PHASE 5<br>**DSR:** Rigor Cycle<br>**PADRE:** Formalization of learning | Chapters One to Eight. | Conclude, synthesize, evaluate, reflect on learning. | **Chapter Nine:**<br>➢ Conclusion.<br>➢ Finalization of thesis.<br>➢ Validated evaluation framework highlighting teacher contributions (**Table 9-3**). |

## 9.6. Reflection on key findings

It is necessary to identify how this study contributes to the extant literature by comparing the criteria identified from literature to the criteria that teachers identified during this research. Furthermore, it is necessary to check if any new literature on this topic has been produced and, if so, how it aligns with the findings.

The final validated eModeration evaluation framework, based on a triangulation of literature findings and teacher contributions, is depicted in **Table 9-3**. Criteria extrapolated from an analysis of the literature reviews of moderation, technology acceptance models, IS Success models, and HCI are differentiated from the evaluation criteria elicited solely from teacher contributions. Teacher contributions (bold and italics) indicate domain-specific criteria obtained from the active participation of teachers and moderators during the different stages of data capturing.

The findings indicate that teachers contributed additional criteria not evident in the extant literature, specifically to the task and system components (see **Table 9-3)**, thus enriching the existing body of knowledge. Engaging teachers and moderators as active participants in all stages of the DSR process was invaluable in obtaining domain-specific criteria. For instance, while the extant literature mentions accessibility as a general criterion for the evaluation of any IT system, participants at focus group interviews vocalized accessibility from the view of the visually impaired.

Considering new literature findings since this study started, a search for digitized moderation revealed only one publication of guidelines for a digital approach to moderation by the Scottish Education department (Education-Scotland, 2022). No evidence is provided of a dedicated medium for digital moderation. Instead, a suggestion is to use an online platform like Teams or OneNote to share documents. The only two points of intersection with this study are that of comments and discussions being recorded in text or voice notes, and all participants being able to access a record of the moderation so further collaboration can occur (Education-Scotland, 2022).

**Table 9-3: Evaluation framework depicting criteria extracted from literature and teacher contributions**

| | Evaluation criteria extracted from literature | Teacher contributions |
|---|---|---|
| **User** | **Post-usage criteria** | |
| | Ease of learning | ***User preferences*** |
| | Self-efficacy | |
| | Training and experience | |
| | Usefulness | |
| | User effectiveness | |
| | User efficiency | |
| | User satisfaction | |
| **Task** | **Pre and post-usage criteria** | |
| | Annotation tools | ***Automatic updates*** |
| | Audit trail | ***Autosave*** |
| | Communication | ***Built in templates*** |
| | Database of comments | ***Calendar*** |
| | Environmentally friendly | ***Functional help*** |
| | Notifications | ***Instant feedback*** |
| | Live chat/feedback | ***Online editing*** |
| | | ***Organized file structure*** |
| | | ***POPIA compliance*** |
| | | ***Shortcut keys*** |
| | | ***Tracking changes*** |
| | | ***Tracking deadlines*** |
| | | ***Tracking documents*** |
| | | ***Versioning*** |
| | **Post-usage criteria** | |
| | Split screen | |
| **System** | **Pre and post-usage criteria** | |
| | Accessibility | ***Integration with cloud storage*** |
| | Centralized data storage | ***Integration with LMS*** |
| | Cross platform | ***Reminders of deadlines*** |
| | File formats | ***Synchronization*** |
| | Platform-independent | ***Integration with cloud storage*** |
| | Reliability | ***Integration with LMS*** |
| | Reporting | |
| | Security | |
| | **Post-usage criteria** | |
| | Dependability | ***Aesthetics*** |
| | Internet connectivity | |

This research is thus opportune at a time when the digitalisation of assessments on the back of the COVID pandemic necessitates cost-effective, remote quality assurance processes. Secondary schools will need to make substantial investments in robust infrastructure for the effective implementation of digital technologies in moderation practices. Amongst the insights gained is that assessment bodies need to reconsider current assessment practises that are largely comprised of handwritten assessments to facilitate effective digitalised moderation practices for teachers to fully benefit from such a system. The findings of this research can be generalised to most environments that require guidelines to evaluate the introduction of an ICT system.

The initial evaluation framework proposed prior to the validation by domain experts was judged to be *"over-subscribed"* with detail. Such detail was in fact necessary for the intended stakeholders, as is evidenced by the comments made during the subsequent interviews. A minimal framework, together with context-specific requirements reiterated through all iterations of data collection, were synthesized to create a framework that could be more easily generalized and "fit for purpose", as specified by Sonnenberg and Brocke (2012, p. 395). The findings confirm evidence from literature indicating that educators prefer systems that enhance the effectiveness and efficiency with which they can complete moderation tasks.

The rich data provided by participants provided valuable insights into context-specific functionality for an eModeration system. Domain experts isolated pertinent aspects based on their "lived" experiences of moderation processes, which not only corroborates but also adds to the existing body of knowledge.

## 9.7. Key contributions

The key theoretical, methodological, and practical contributions of this study are presented in the following sections.

### 9.7.1. Theoretical contribution

Based on their level of problem and solution maturity, DSR projects can make various types of research contributions. Potential DSR research contributions are illustrated in **Figure 9-1**. The goal of DSR in the improvement quadrant is to create more efficient solutions for a known application context. Given that no empirical evidence could be found of existing eModeration systems, the theoretical contribution of this study is situated in the improvement quadrant. The main theoretical contribution is the empirically based domain-specific design requirements for an eModeration system that were extracted from literature and PD workshops. The design requirements at the intersection of the HCI and IS fields can be used to assist developers in designing an eModeration system. The second theoretical contribution is the theoretical framework that was abstracted from literature, and that informed the theoretical grounding of this study (see **Figure 9-1**).

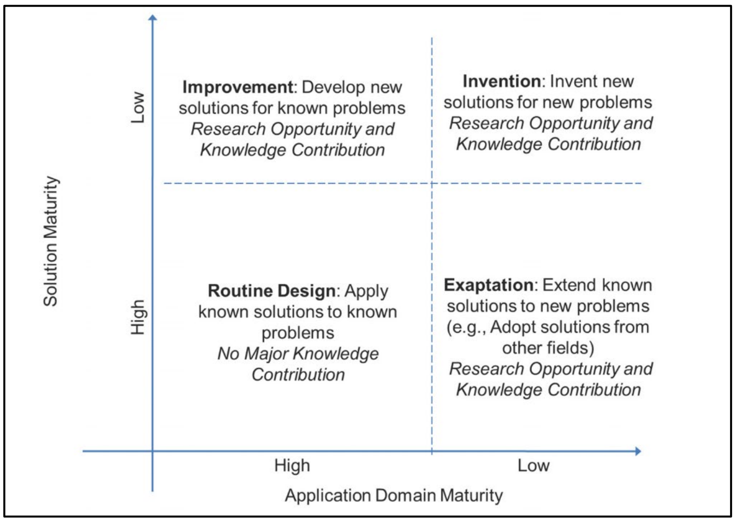



**Figure 9-1**: **DSR knowledge contribution framework** (Gregor & Hevner, 2013)

The design requirements and UX constructs were used to develop a prototype eModeration system. The eModeration evaluation framework is useful for stakeholders when evaluating the suitability of an eModeration system, while the design requirements are necessary for those developing a system. The combination of the Relevance Cycle of the DSR process to include teacher inputs during two PD workshops and the Rigour Cycle of evaluation and validation resulted in a validated artefact to address the problem of evaluating the user experience of an eModeration system.

A triangulation of the findings of the literature review, survey, focus groups, and expert interviews provided evidence-based context-specific pre- and post-moderation criteria. These criteria provided a theoretical basis for developing requirements and evaluation guidelines for eModeration systems.

### 9.7.2. Methodological contribution

Methodologically, the integration of a PD data capturing strategy within DSR was key in aligning DSR and PD to augment the relevance of this research to the education fraternity. DSR and PD have similarities (see **Section 4.2.2.3.),** but these similarities have not been widely theorized. This study contributed by the publication of a conference paper detailing the similarities and the application of PD within the DSR cycle (Rajamany et al., 2022).

PD was implemented via the PADRE evaluation cycles, as recommended by Haj-Bolouri et al. (2016). The mapping of PADRE to the iterative DSR cycles is a novel methodological contribution detailing the entry point of PD and situating the user firmly as a part of the research during all stages of the DSR process. A problem-centred approach underpinned this study. Hence, the design process depicted in **Figure 9-2** is framed within the six activities outlined in the Design Science Research Process (DSRP) model developed by Peffers et al. (2006).

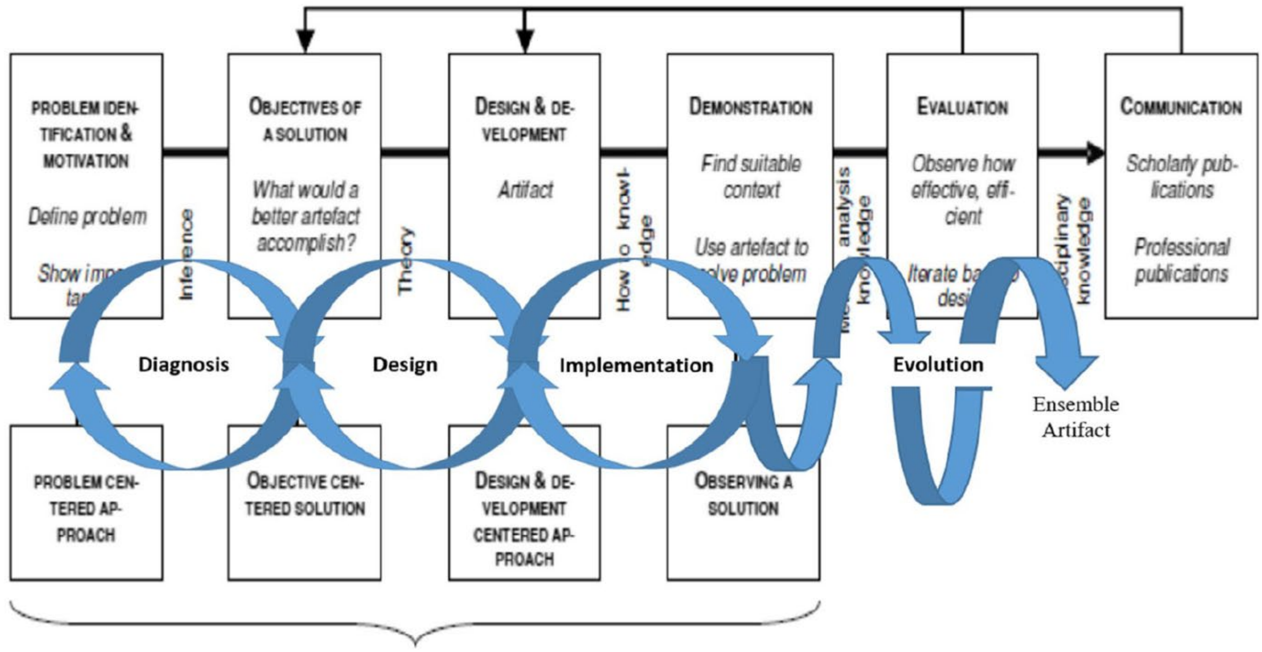



**Figure 9-2: ADR process and DSR process models overlay (Mullarkey & Hevner, 2019)**

### 9.7.3. Practical contributions

The four practical contributions made by this research are explained as follows:

- The user experience evaluation questionnaire based on the CSUQ and USE questionnaires for which the construct validity was established, is a theoretical contribution with a practical implementation.

- Knowledge sharing during the design process fostered an in-depth understanding of the needs of potential users (teachers and moderators) of an eModeration system. The eModeration prototype provided an artefact for educators to interact with, considering that there are no dedicated eModeration systems currently in place in the secondary school environment.

- The eModeration requirements (to create the prototype) identified from literature, and then refined by triangulation with the empirical findings of the feedback on the prototype (online survey), have practical value in guiding the design of eModeration systems for the secondary school environment.

- Differentiating between pre- and post-adoption criteria is valuable when considering the adoption of an eModeration system. The guidelines proposed for pre- and post-adoption are valuable contributions for eModeration system adoptees to evaluate the merits and demerits of various systems under consideration.

## 9.8. Limitations

The limitations of this study pertain to the generalizability of the study, the availability of applicable literature, the target audience, and the sample size.

This study was conducted within the secondary school domain, specifically in the context of South African moderation policies and practices as stipulated by the independent national examining body. As such, the artefact (eModeration evaluation framework) is not generalizable to other countries. The eModeration evaluation framework was evaluated by eight domain experts. An application and evaluation in other contexts, specifically on a variety of artefacts, would provide further validation of the design of the evaluation framework. Research in more schools (independent and public) since independent schools have different contexts and resources from public schools, as well as with more teachers of various subjects is necessary before the findings can be generalized to secondary schools in SA. It is also necessary to evaluate the eModeration evaluation framework in other phases of the schooling environment.

Concerning the availability of applicable literature specifically on eModeration, when eModeration was used as a search phrase, the focus of the resulting articles was on the mediation of online discussion groups rather than on the digital moderation of assessments, which is the key focus area of this study. Relevant research within the SA background was limited to that of Van Staden (2010); Van Staden et al. (2015); Van Staden (2017); Van Staden et al. (2017), and Rajamany et al., (2020a, 2020b). The lack of published investigations into eModeration specifically at secondary schools was a limitation. However, the limited availability of publications strengthened the rationale for this study.

Teachers were the target audience. Any kind of system that requires some sort of learning curve requires time to be spent working with the system. Preferably, users should have unlimited time for interacting with a new system before evaluating it. That is not always practical, as in this case. Teachers therefore did not have time to truly engage with the prototype eModeration system. More time spent using the system would probably have enriched the findings.

The PD activity involved 16 participants. The interaction with the prototype was limited to educators in one private secondary school. A limited number of 40 teachers interacted with the prototype; the sample size was thus small. Additionally, the availability of teachers was constrained by their busy schedules, which further reduced the number of respondents.

## 9.9. Future research

A theoretical framework was introduced in Chapter Three (see **Figure 3-14**) and implemented in the prototype. Future research is necessary to engage additional stakeholders, such as assessment bodies and school management, in designing an eModeration system that provides flexibility in serving the needs of all stakeholders. Having evaluated the eModeration evaluation framework in the context of independent schools, the implementation of the eModeration evaluation framework in public secondary schools and amongst teachers in other phases of schooling needs to be investigated.

It is necessary to determine how feedback on the utility of the evaluation framework can be expanded to conduct a formal evaluation of either an existing or a potential eModeration system. Future research can therefore investigate how IT designers, developers and researchers can apply the framework in situ.

The importance of context has been highlighted at various stages in this research. The focus for future research would therefore be to observe and analyse the application of an eModeration system in practice within a specific usage context to establish a balance between the extremes of “nice to have” and the absolute minimum specifications for the artefact in practice. A related area for future research would be to consider how generalizing the guidelines for the evaluation of other software systems can enhance the generality of the eModeration evaluation framework.

## 9.10. Personal reflection

The compilation of this thesis was a journey of discovery and endurance. Beginning this journey at the height of the COVID pandemic, although opportune, proved to be difficult; especially considering the need for the active engagement of participants in the data capturing strategy. The most difficult aspect of completing this thesis was juggling the demands of a full-time job with the time required to complete this thesis.

The most significant aspect of the research was that insights gleaned were obtained from participants’ direct experience of moderation processes, which I believe enriched the findings. However, the most challenging aspect was assimilating these different views to provide my own interpretation using my “voice”. The completion of this process provided me with a greater understanding of the digital moderation space.

In addition to gaining new knowledge, the requisite rigour of a Ph.D thesis required a maturation in my writing skills, and has enhanced my personal qualities and approach to becoming an effective researcher. This process has allowed me to grow as an individual, enabling me to develop transferable skills such as effectively communicating my research to different audiences; developing a more detailed understanding of statistical techniques; enhancing my analysis of qualitative and quantitative data; and writing with a clear sense of purpose and cohesiveness. I have learnt the importance of accurately and objectively stating facts and figures.

## 9.11. Conclusion

This chapter concludes the thesis by providing a synopsis of the thesis and outlining the research problem and the gaps identified in the extant literature. A summary of the research design and data capturing strategy was presented. Evidence of how the research questions were answered was presented, together with an outline of where in this study these research questions were addressed and the respective research outcomes. A discussion of the key findings was presented, together with a discussion of the limitations of this study. Areas for future research are proposed. I also offer a personal reflection of the insights gained and the personal growth that occurred during the process of compiling this research. In response to the main research question, the identified user-, task-, and system-based criteria provided an empirically based, teacher-informed foundation to guide the development of a validated UX evaluation framework for an eModeration system. This study has made practical, theoretical, and methodologically based contributions to the development and evaluation of eModeration systems and provided guidelines for the evaluation thereof. The objectives of the study were therefore satisfied.

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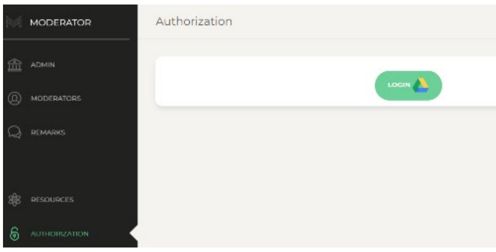
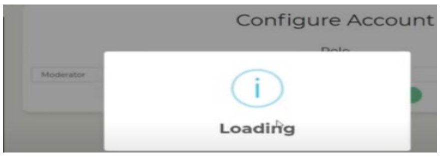
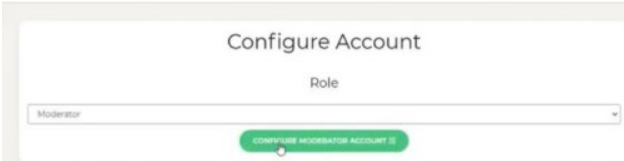
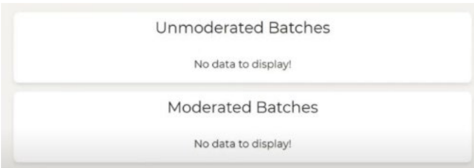
## Appendix A: Prototype Version 1

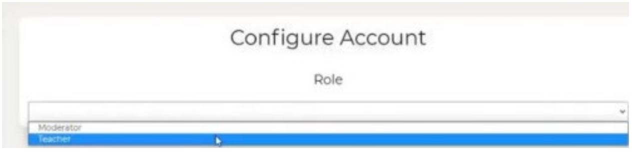


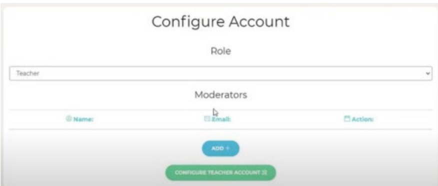


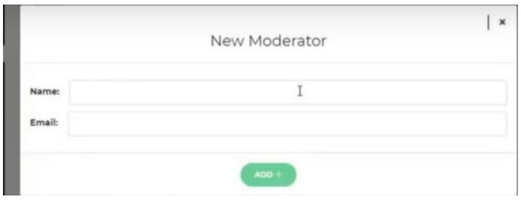


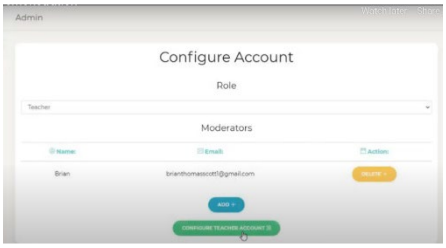



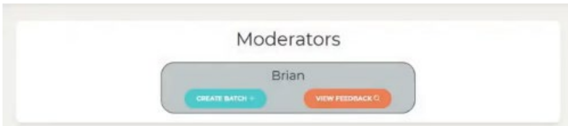



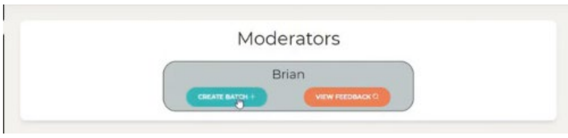



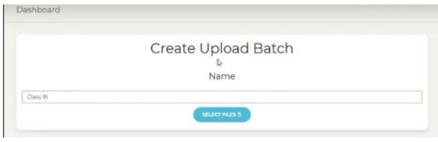



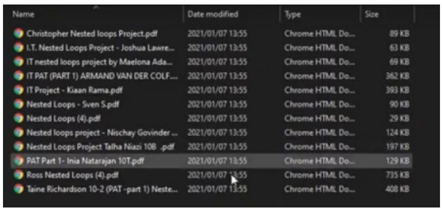



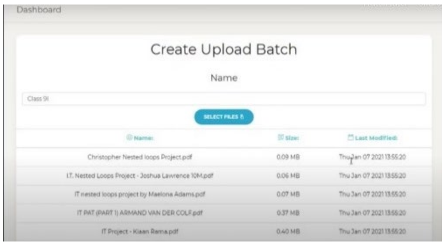

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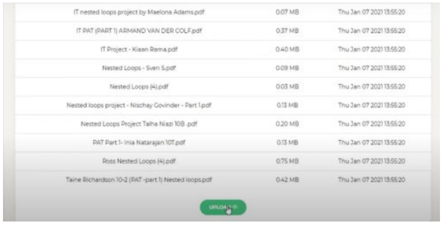
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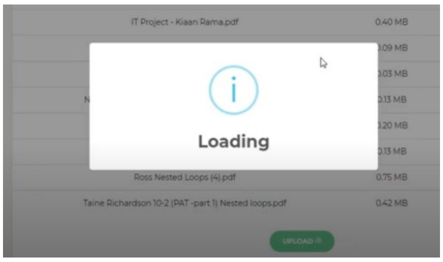
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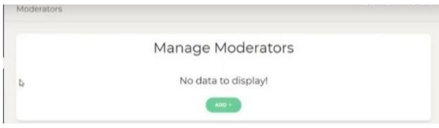
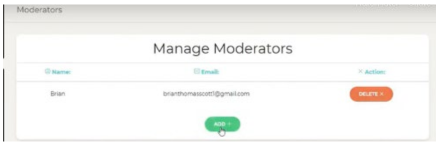
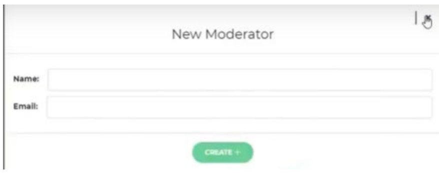
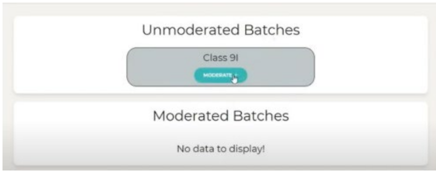
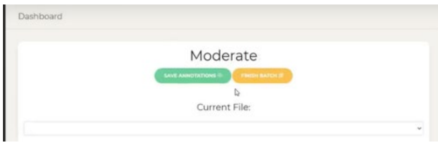
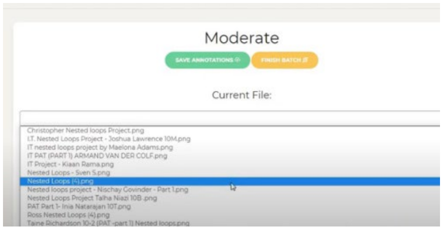

Moderators
Manage Moderators
No data to display!

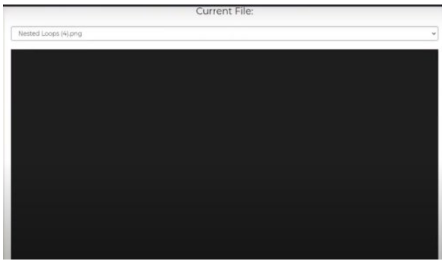

Moderators
Manage Moderators
Brian
DELETE

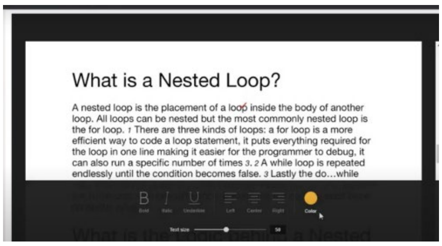

New Moderator
Name:
Email:
CREATE

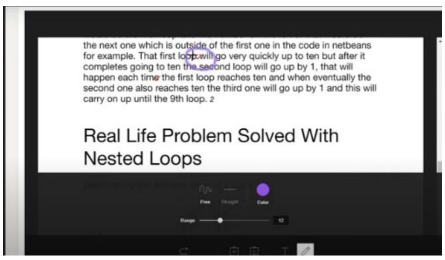

Unmoderated Batches
Class 9I
MODERATE
Moderated Batches
No data to display!

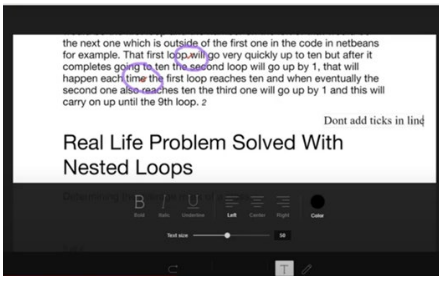

Dashboard
Moderate
Current File:

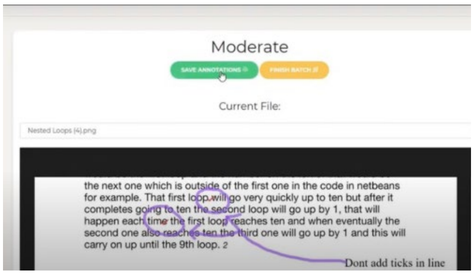

Moderate
Current File:
Christopher Nested loops Project.png
I.T. Nested Loops Project - Joshua Lawrence 10M.png
IT nested loops project by Maelona Adams.png
IT PAT (PART 1) ARMAND VAN DER COLF.png
IT Project - Kiaan Rama.png
Nested Loops - Sven S.png
Nested Loops (4).png
Nested loops project - Nischay Govinder - Part 1.png
Nested Loops Project Talha Niazi 10B.png
PAT Part 1- Inia Natarajan 10T.png
Ross Nested Loops (4).png
Taine Richardson 10-2 (PAT -part 1) Nested loops.png

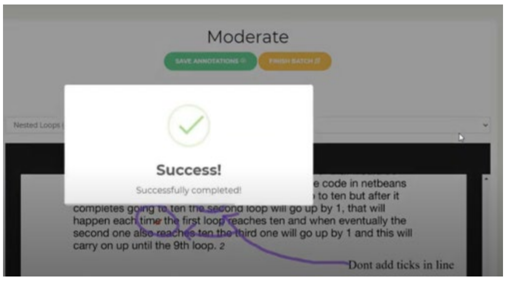

Current File:
Nested Loops (4).png

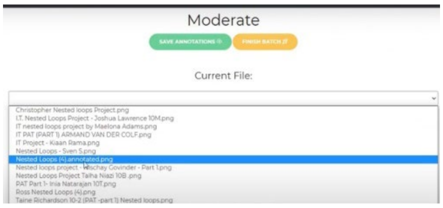

What is a Nested Loop?
A nested loop is the placement of a loop inside the body of another loop. All loops can be nested but the most commonly nested loop is the for loop. 1 There are three kinds of loops: a for loop is a more efficient way to code a loop statement, it puts everything required for the loop in one line making it easier for the programmer to debug, it can also run a specific number of times 3. 2 A while loop is repeated endlessly until the condition becomes false. 3 Lastly the do…while

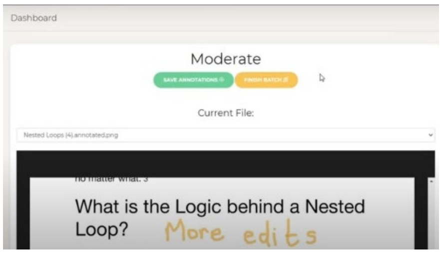

the next one which is outside of the first one in the code in netbeans for example. That first loop will go very quickly up to ten but after it completes going to ten the second loop will go up by 1, that will happen each time the first loop reaches ten and when eventually the second one also reaches ten the third one will go up by 1 and this will carry on up until the 9th loop. 2
Real Life Problem Solved With Nested Loops

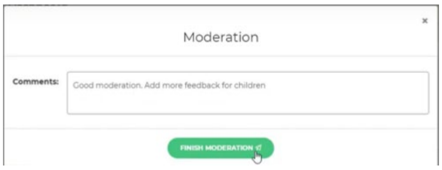

the next one which is outside of the first one in the code in netbeans for example. That first loop will go very quickly up to ten but after it completes going to ten the second loop will go up by 1, that will happen each time the first loop reaches ten and when eventually the second one also reaches ten the third one will go up by 1 and this will carry on up until the 9th loop. 2
Dont add ticks in line
Real Life Problem Solved With Nested Loops

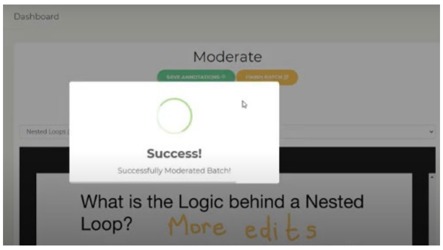

Moderate
Current File:
Nested Loops (4).png
the next one which is outside of the first one in the code in netbeans for example. That first loop will go very quickly up to ten but after it completes going to ten the second loop will go up by 1, that will happen each time the first loop reaches ten and when eventually the second one also reaches ten the third one will go up by 1 and this will carry on up until the 9th loop. 2
Dont add ticks in line

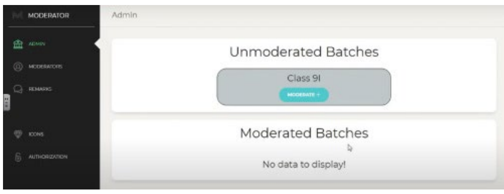

Moderate
Success!
Successfully completed!
Dont add ticks in line

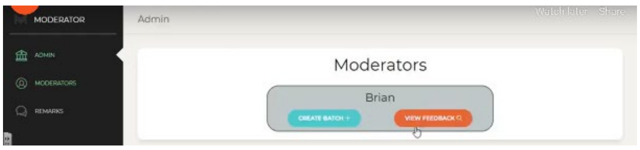

Moderate
Current File:


Dashboard
Moderate
Current File:
What is the Logic behind a Nested Loop?
More edits

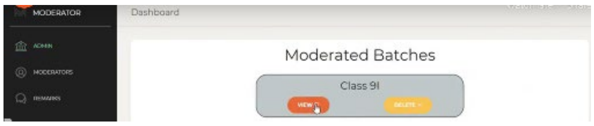

Moderation
Comments:
Good moderation. Add more feedback for children
FINISH MODERATION

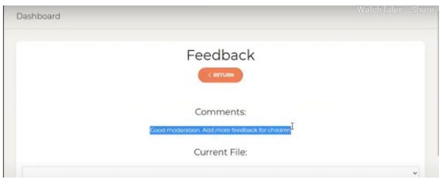

Dashboard
Moderate
Success!
Successfully Moderated Batch!
What is the Logic behind a Nested Loop?
More edits

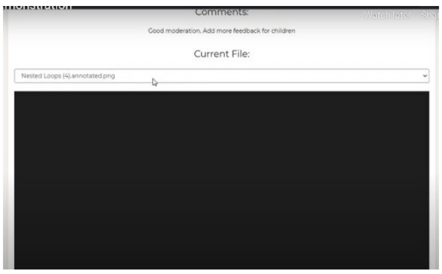

MODERATOR
Admin
Unmoderated Batches
Class 9I
Moderated Batches
No data to display!

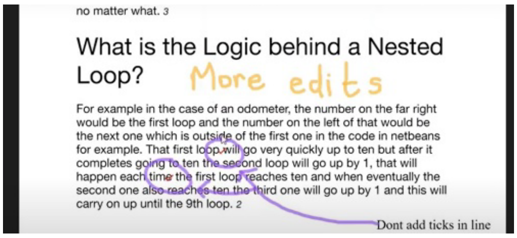

MODERATOR
Admin
ADMIN
MODERATORS
REMARKS
Moderators
Brian

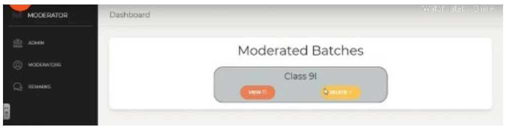

MODERATOR
Dashboard
Moderated Batches
Class 9I

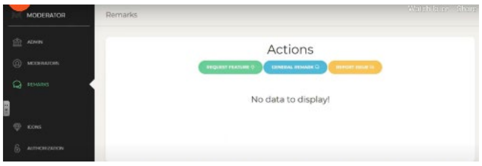

MODERATOR
Dashboard
Moderated Batches
Class 9I

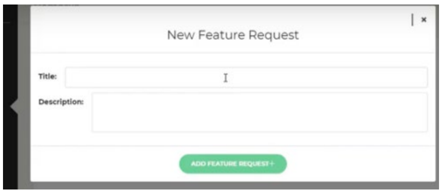

Dashboard
Feedback
Comments:
Current File:

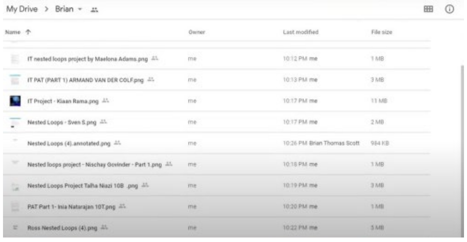

Comments:
Good moderation. Add more feedback for children
Current File:

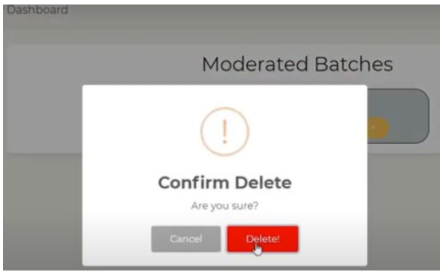

no matter what. 3
What is the Logic behind a Nested Loop?
More edits
For example in the case of an odometer, the number on the far right would be the first loop and the number on the left of that would be the next one which is outside of the first one in the code in netbeans for example. That first loop will go very quickly up to ten but after it completes going to ten the second loop will go up by 1, that will happen each time the first loop reaches ten and when eventually the second one also reaches ten the third one will go up by 1 and this will carry on up until the 9th loop. 2
Dont add ticks in line


MODERATOR
Dashboard
Moderated Batches
Class 9I


MODERATOR
Remarks
Actions
No data to display!


New Feature Request
Title:
Description:
ADD FEATURE REQUEST +


My Drive > Brian
Name
Owner
Last modified
File size
IT nested loops project by Maelona Adams.png
me
10:12 PM me
1 MB
IT PAT (PART 1) ARMAND VAN DER COLF.png
me
10:13 PM me
3 MB
IT Project - Kiaan Rama.png
me
10:17 PM me
11 MB
Nested Loops - Sven S.png
me
10:17 PM me
2 MB
Nested Loops (4).annotated.png
me
10:26 PM Brian Thomas Scott
984 KB
Nested loops project - Nischay Govinder - Part 1.png
me
10:18 PM me
1 MB
Nested Loops Project Talha Niazi 10B .png
me
10:19 PM me
3 MB
PAT Part 1- Inia Natarajan 10T.png
me
10:20 PM me
1 MB
Ross Nested Loops (4).png
me
10:22 PM me
5 MB


Dashboard
Moderated Batches
Confirm Delete
Are you sure?
Cancel
Delete!


Remarks
Actions
No data to display!

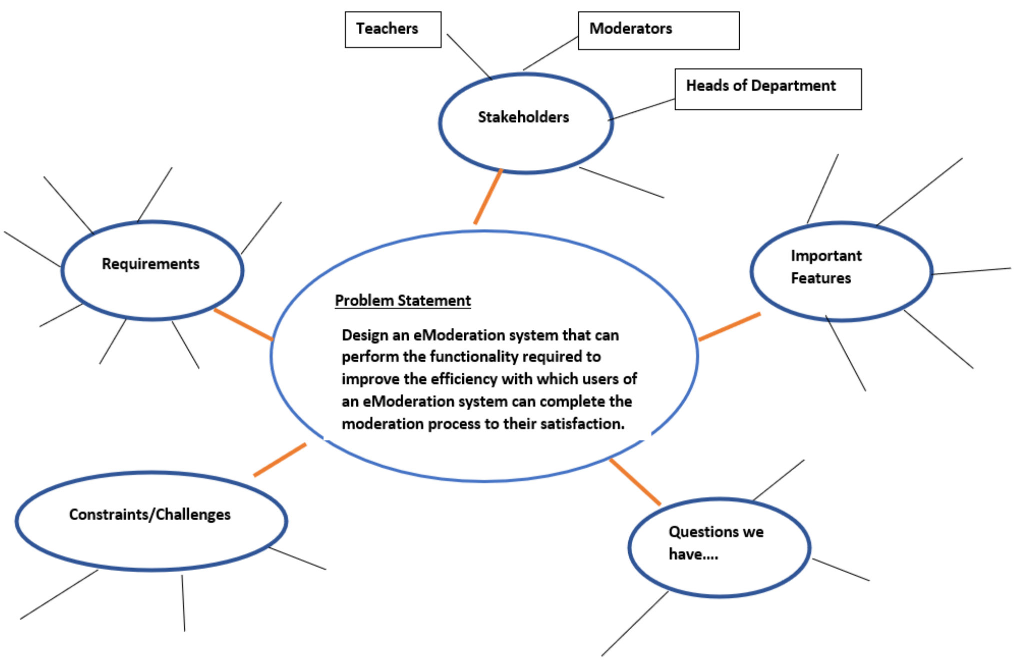
## Appendix B: Idea Web Template Requirements

### a) User feedback table:

**Fill in the following table**

| Question | Response |
|---|---|
| Why would you use an eModeration system? | |
| What system(s) do you currently use? | |
| What do you like about your current moderation systems or processes? | |
| What do you dislike about existing moderation systems or processes? | |
| What improvements would you make to existing moderation systems or the system that you currently use for moderation? | |
| What functionality would you include in an eModeration system? | |
| Your own question | |

### b) Idea Web Template



c) Considering the user statements/answers in the table above, group repeating comments together by using a descriptive word to identify common themes (e.g., security) so that the themes clearly indicate or identify what the user *needs* from an eModeration system. Fill in the identified themes in the table below.

| | Themes Identified |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |
| 7 | |
| 8 | |
| 9 | |
| 10 | |

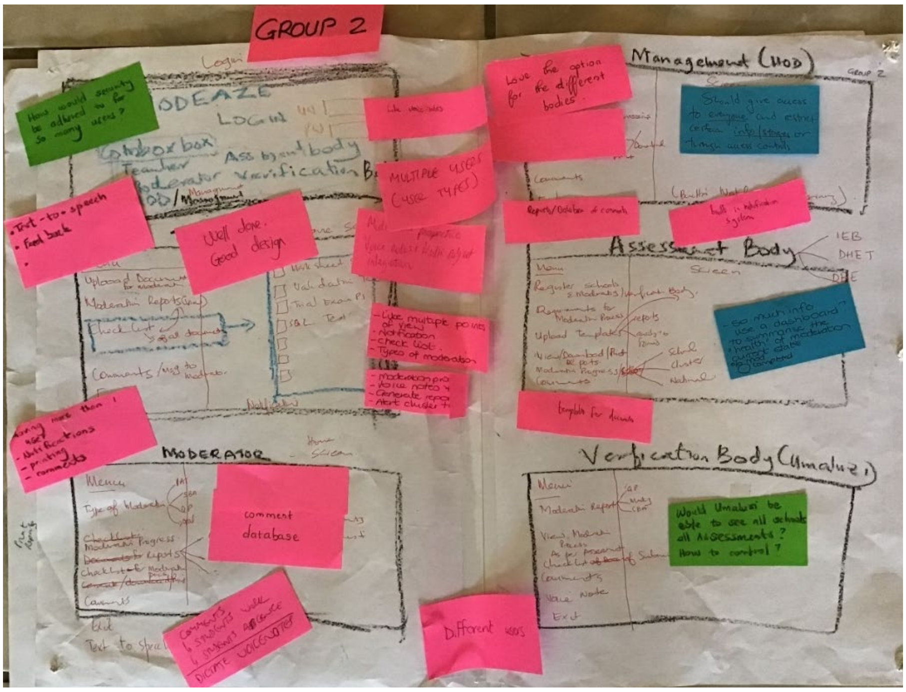
3. Discuss the themes that have emerged in your groups. Use the descriptive word/theme to rank the needs in the table below in order of importance for the user (with 1 being the most important).

| Rank | Themes Identified |
|---|---|
| 1 | |
| 2 | |
| 3 | |
| 4 | |
| 5 | |
| 6 | |

## Appendix C: Design ideas

| Question number | Question | GROUP 1 Responses<br>Participant A1 | Participant B1 | Participant C1 | Participant D1 |
|---|---|---|---|---|---|
| 1 | Why would you use an eModeration system? | To facilitate regional and national PAT and SBA moderation. | Collective organization of data. Easy, quick referencing. Scalability. | To moderate either regional or national mechanism/moderations. To ease the administrative pressures that comes with moderation. | It makes it easy to get submissions. Things are available in one place. |
| 2 | What system(s) do you currently use? | One Drive IEB Postbox for reporting. | Text-based editor and checklist. Postbox, Dropbox. | A combination of electronic cloud storage and physical hard copy portfolio. Some make use of Google Drive shared folder. | Google Drive. One Drive. |
| 3 | What do you like about your current moderation systems or processes? | Easy for teachers to access via a link to One Drive. | Easy fill in; quick; flexible. | There is flexibility. The overall ease of needing to send soft copies makes the organisation of the portfolio easier. No need to send hard copies via courier, saving costs and time. Fixing mistakes is easier as files/portfolios are online. | It has the ability to share restricted links. There is an ease of access. |
| 4 | What do you dislike about existing moderation systems or processes? | Have to set up on One Drive folders for school; have to restrict access to folder. Have to email link. Then have to post reports on IEB Postbox. | Quality of data is not informative. No set standard for uniformity. Time consuming (administration). | It is not a formative experience. Many have an adversarial view of the moderation process. There are a lot of boxes/requirements to meet. The deadlines are not always possible or teachers do not check the deadlines. | One Drive, Links expire too quickly. Restricted capacity. |
| 5 | What improvements would you make to existing moderation systems or the system that you currently use for moderation? | Upgrade IEB Postbox to include facilities where teachers can upload SBA and PAT in predefined organised folders. | Set a common standard/pattern/ checklist for uniformity. A defined stages-of-completion to-do list in order to stratify processes. Organize each stage/process according to its order or priority. | I would start involving teachers much earlier. Make sure that any additional requirements are clearly communicated. Make a template for the required works. Have a financial incentive for cluster members to create shared papers. Make online submission XXX defaults. | It would be nice to have more features, but at the same time make it user friendly. Organisational setup needs to be a priority, as this will enable users to be comfortable. |
| 6 | What functionality would you include in an eModeration system? | Alert teacher if required SBA and PAT requirements are not submitted within the required timeframe. IEB liaison officers must be alerted as well. | Ability to cross-reference and synch with all documents or items moderated. Stage by stage analysis of content/completion. No specific system (LMS) (CMS). | The ability to include assignment-style portfolio items. Tracked deadines. Ticket/Help system. | Notification errors if things are missing, or requirement not met. A notification when things are uploaded, edited, and/or deleted. |

| Question number | Question | GROUP 1 | | | |
|---|---|---|---|---|---|
| | | Responses | | | |
| | | Participant A1 | Participant B1 | Participant C1 | Participant D1 |
| 7 | Your own question | What happens if there is no electricity or Internet access? What process will still be in place to facilitate eModeration? | | Would you find a FAQ document useful? | |

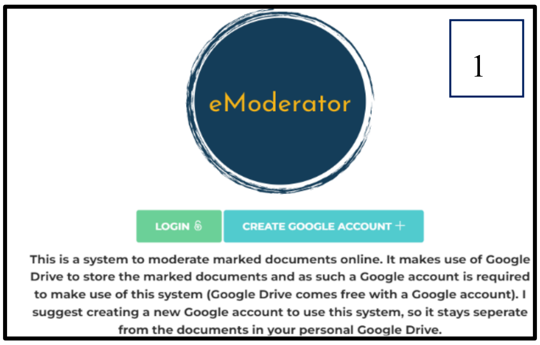


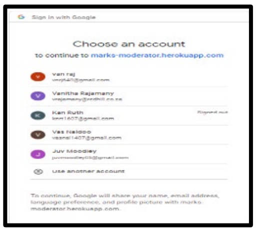
## Appendix D: Prototype Version 2

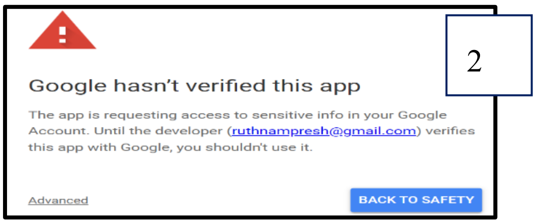
The researcher acted as facilitator in supporting teachers who have connectivity issues with the use of the technology, but are not involved with the moderation of student work samples.

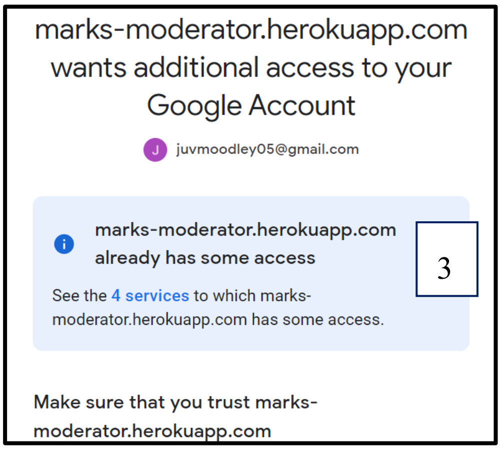
## A: Teacher and/or moderator log

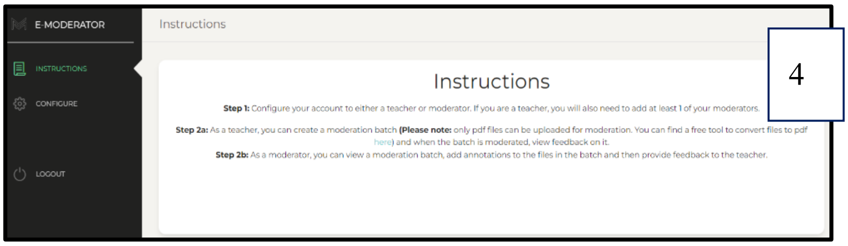
### Log in screen



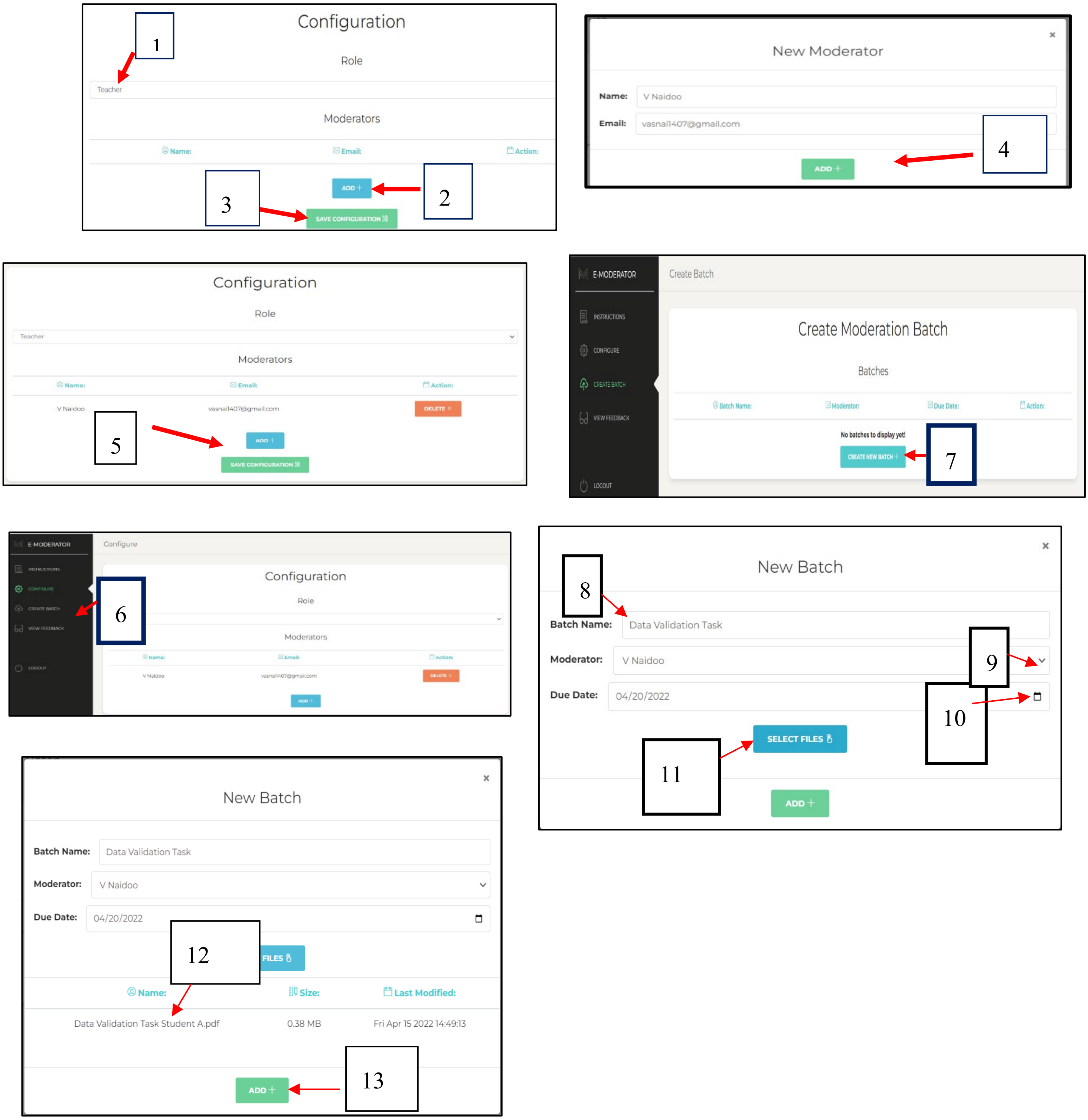



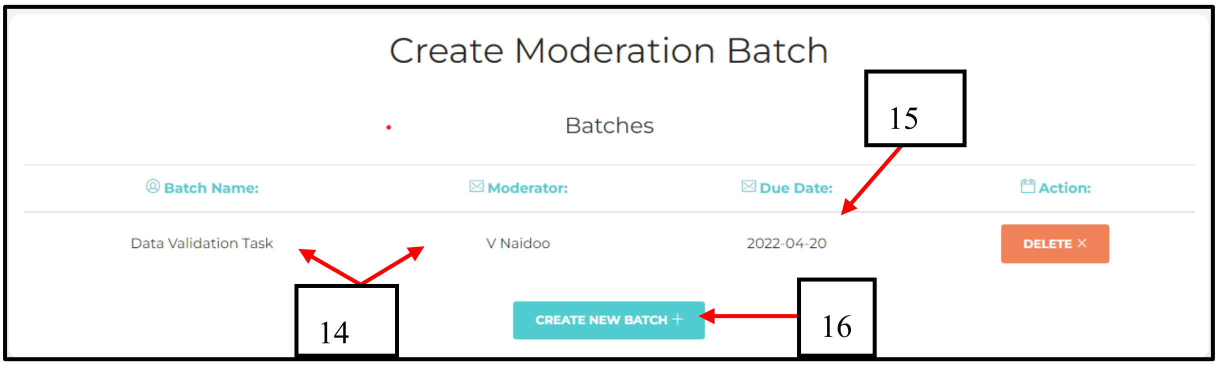



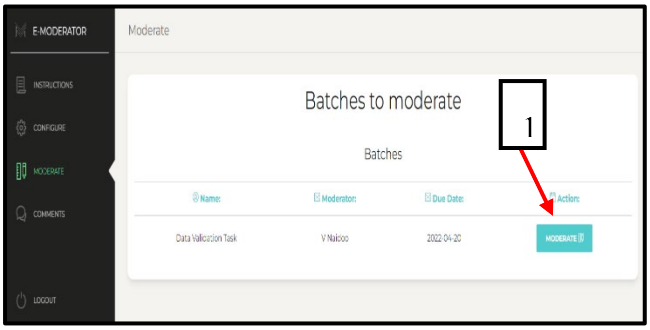



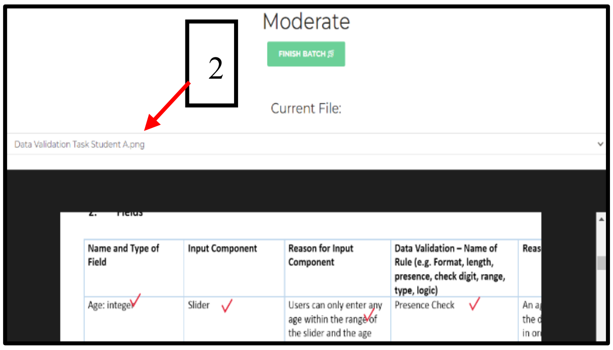

## B: Teacher View:

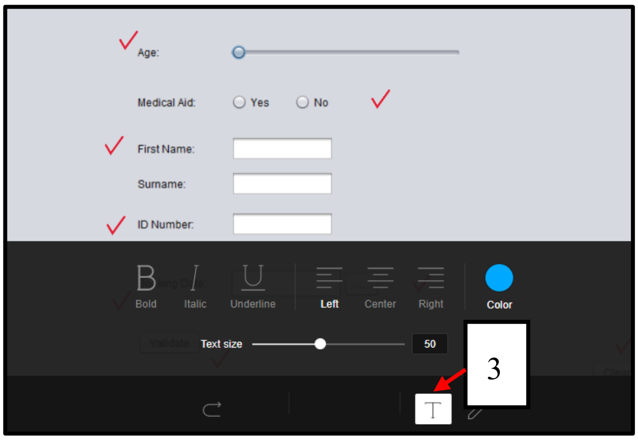


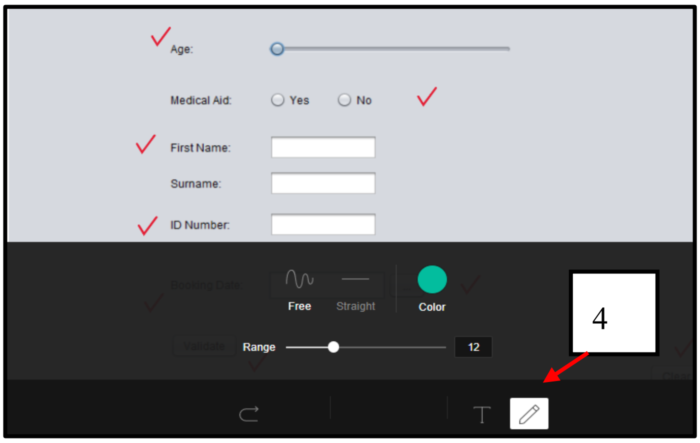


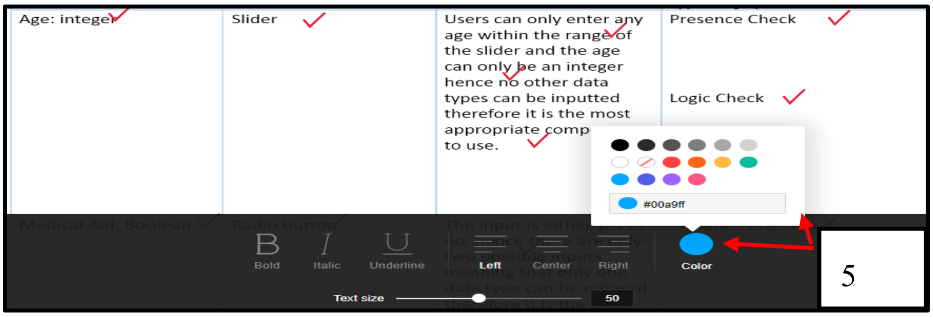

## C. Moderator View:

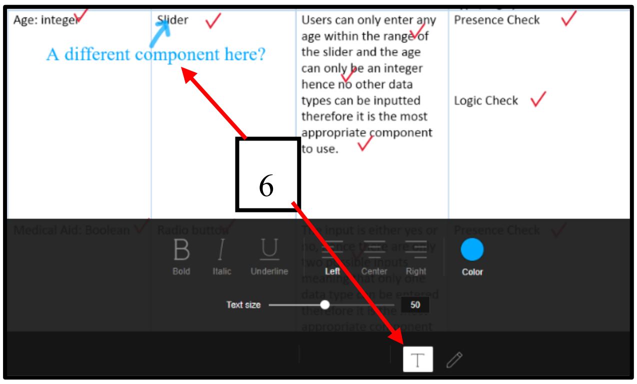


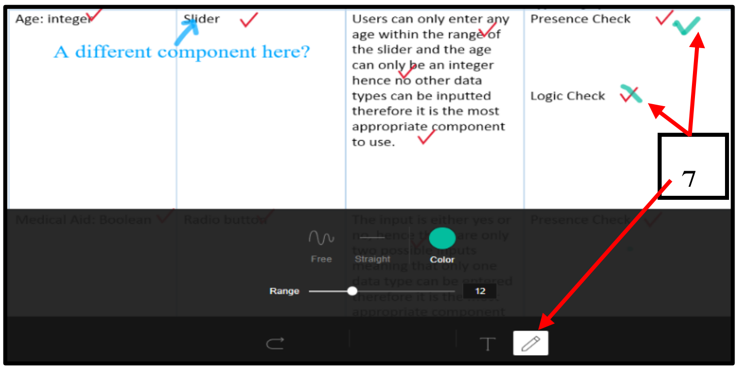



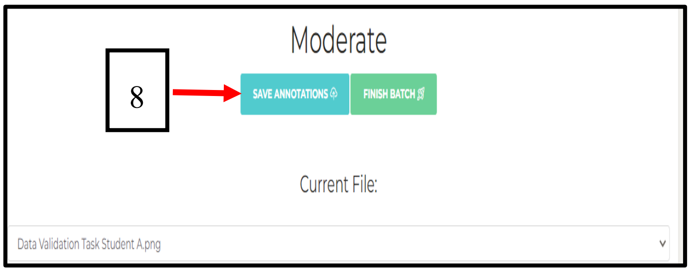



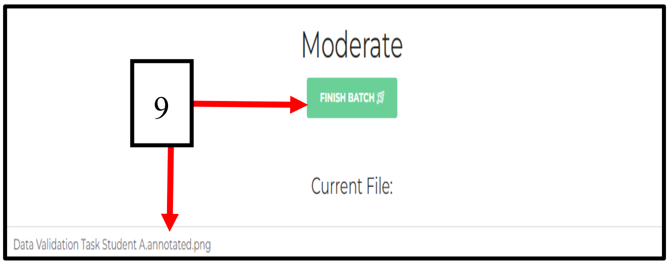




Age: integer
Slider
A different component here?
Users can only enter any age within the range of the slider and the age can only be an integer hence no other data types can be inputted therefore it is the most appropriate component to use.
Presence Check
Logic Check
6
Bold
Italic
Underline
Left
Center
Right
Color
Text size
50

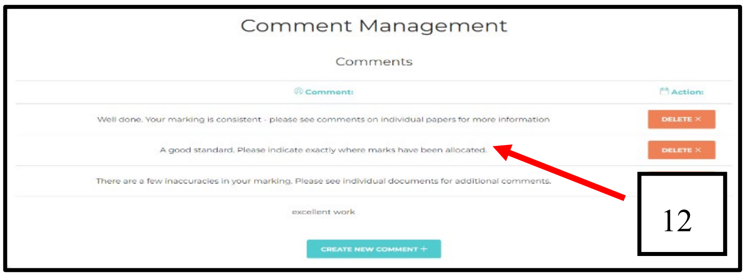

Age: integer
Slider
A different component here?
Users can only enter any age within the range of the slider and the age can only be an integer hence no other data types can be inputted therefore it is the most appropriate component to use.
Presence Check
Logic Check
7
Free
Straight
Color
Range
12

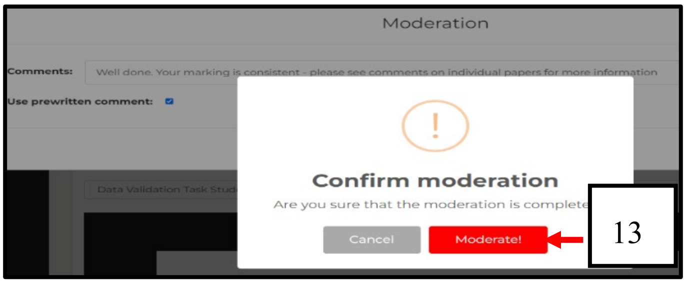

Moderate
8
SAVE ANNOTATIONS
FINISH BATCH
Current File:
Data Validation Task Student A.png

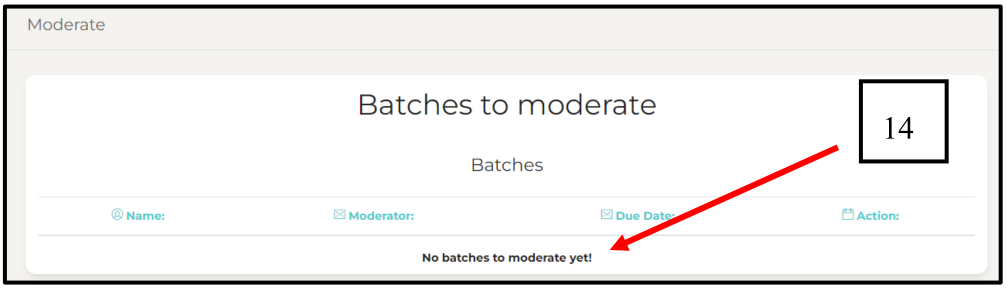

Moderate
9
FINISH BATCH
Current File:
Data Validation Task Student A.annotated.png


Moderation
Comments:
Use prewritten comment:
10
FINISH MODERATION

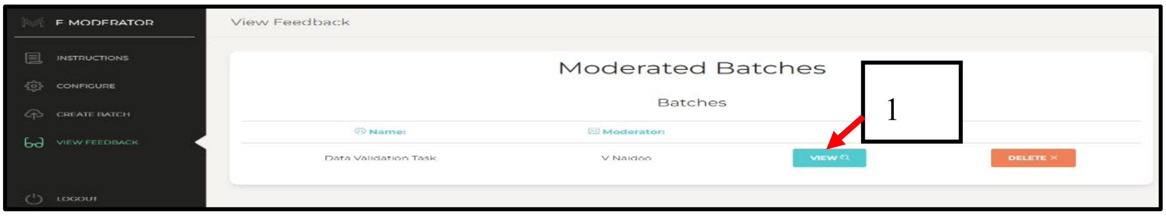

Moderation
Comments:
Well done. Your marking is consistent - please see comments on individual papers for more information
Use prewritten comm
11
FINISH MODERATION

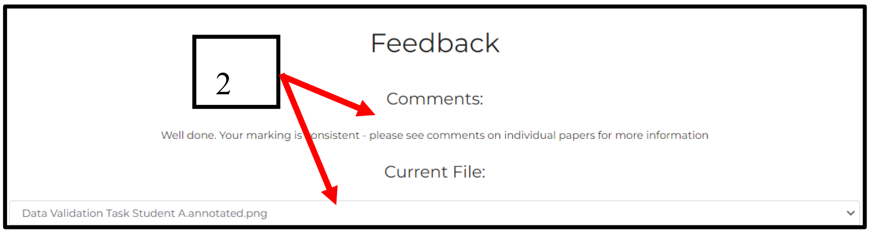

Comment Management
Comments
Comment:
Action:
Well done. Your marking is consistent - please see comments on individual papers for more information
DELETE
A good standard. Please indicate exactly where marks have been allocated.
DELETE
There are a few inaccuracies in your marking. Please see individual documents for additional comments.
excellent work
CREATE NEW COMMENT +
12

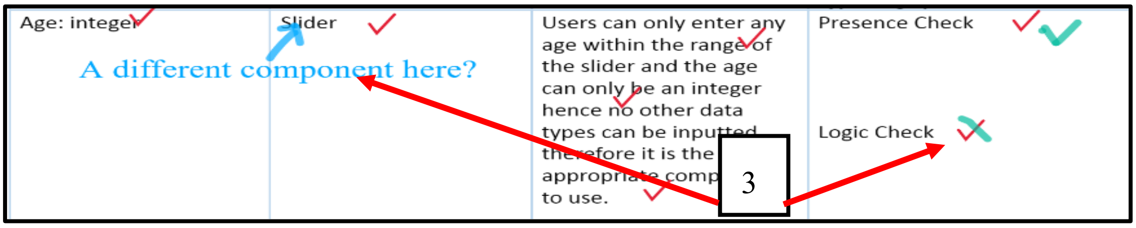

Moderation
Comments:
Well done. Your marking is consistent - please see comments on individual papers for more information
Use prewritten comment:
Confirm moderation
Are you sure that the moderation is complete
Cancel
Moderate!
13


Moderate
Batches to moderate
14
Batches
Name:
Moderator:
Due Date:
Action:
No batches to moderate yet!

## D: Teacher view after moderation:



# Appendix E: Online Survey Questionnaire

eModeration Prototype Evaluation 2022

Ethical clearance #: 2021/CSET/SOC/071

COVER LETTER TO AN ONLINE ANONYMOUS WEB-BASED SURVEY

Dear Prospective participant,

You are invited to participate in a survey conducted by Vanitha Rajamany under the supervision of Associate Professor C. J. Van Staden and Professor J. Van Biljon in the School of Computing towards a Ph. D in Information systems at the University of South Africa.

The survey you have received has been designed to determine what the components of a user experience evaluation framework for a digital moderation (eModeration) system are. You were selected to participate in this survey because of your role as a teacher and/or moderator. By completing this survey, you agree that the information you provide may be used for research purposes, including dissemination through peer-reviewed publications and conference proceedings.

It is anticipated that the information gained from this survey will help to inform the next steps in formulating a framework to evaluate the UX of an eModeration system in secondary schools with an emphasis on usability.

You are, however, under no obligation to complete the survey and you can withdraw from the study prior to submitting the survey. The survey is developed to be anonymous, meaning that we will have no way of connecting the information that you provide to you personally.

Consequently, you will not be able to withdraw from the study once you have clicked the send button based on the anonymous nature of the survey. If you choose to participate in this survey it will take up no more than 15 minutes of your time. You will not benefit from your participation as an individual, however, it is envisioned that the findings of this study will create opportunities to ease the workload of already overburdened teachers, contribute both to research as well as the professional practice of IT educators and moderators and serve as a template for the employment of a digital moderation system within the secondary school sector in all subject areas.

We do not foresee that you will experience any negative consequences by completing the survey. The researcher undertakes to keep any information provided herein confidential, not to let it out of my possession and to report on the findings from the perspective of the participating group and not from the perspective of an individual.

The records will be kept for five years for audit purposes where after it will be permanently destroyed. Electronic versions will be permanently deleted from Google drive. You will not be reimbursed or receive any incentives for your participation in the survey.

The research was reviewed and approved by the Research Ethics Review Committee of the School of Computing Unisa. The primary researcher, Vanitha Rajamany, can be contacted during office hours at 7232969@mylife.unisa.ac.za. The study leaders, Prof C. J. Van Staden and Prof J. Van Biljon, can be contacted during office hours at vstadcj1@unisa.ac.za and vbiljja@unisa.ac.za respectively. Should you have any questions regarding the ethical aspects of the study, you can contact the chairperson of the Research Ethics Review Committee of the School of Computing Unisa, Dr D. Bischoff at dbischof@unisa.ac.za.

Alternatively, you can report any serious unethical behaviour at the University's Toll Free Hotline 0800 86 96 93.

**Section A: Biographical Information of Participant**

**Section B: Usability**

**Section C: User Experience**

**Section D: General**

You are making a decision whether or not to participate by continuing to the next page. You are free to withdraw from the study at any time prior to clicking the send button.

Thank you very much for your collaboration. Your input is really important to this study.

Email:

Section A: Biographical Information of Participant

1. Age of participant:

| 1.1. 18 – 24 | 1.2. 25 – 34 | 1.3. 35 – 44 | 1.4. 45 – 54 | 1.5. 55+ |
|---|---|---|---|---|
| | | | | |

2. Gender:

| 2.1. Male | 2.2. Female |
|---|---|
| | |

3. Home language:

| 3.1. English | 3.2. Afrikaans | 3.3. isiZulu | 3.4. Xhosa | 3.5. Sotho | 3.6. Other |
|---|---|---|---|---|---|
| | | | | | |

4. Institution at which participant is employed

| 4.1. Private school | | 4.2. Public school |
|---|---|---|
| | | |

5. Participant's designation within the institution

| 5.1. Faculty head | 5.2. Head of department | 5.3. School management |
|---|---|---|
| | | |

6. Subject area

| | |
|---|---|
| Languages | |
| Humanities | |
| Mathematics | |
| Sciences | |
| Arts | |
| Business | |
| Commerce | |
| IT | |
| Other | |

7. Participant role:

| | |
|---|---|
| 7.1. Teacher | |
| 7.2. Internal moderator | |
| 7.3. Cluster moderator | |
| 7.4. Regional moderator | |
| 7.5. National moderator | |

8. Experience in the use of technology

| 8.1. <1 year | 8.2. 1 -5 years | 8.3. 6-10 years | 8.4. >10 years |
|---|---|---|---|
| | | | |

9. Software Experience: I use the following applications in my job

| Application | Never | Seldom | Sometimes | Often | Always |
|---|---|---|---|---|---|
| Word processor | | | | | |
| eMail | | | | | |
| Virtual learning environment | | | | | |
| eModeration systems | | | | | |

10. Have you ever used an eModeration environment to moderate examination scripts electronically before this system?

| 10.1. Yes | 10.2. No |
|---|---|
| | |

Section B: Usability

Procedure to follow when using the eModerate system as a moderator:

Go to the URL: https://marks-moderator.herokuapp.com/#/login

Use your gmail address to log into the system.

Browse the site to familiarise yourself with the system

After completion of the above 3 instructions, please answer the following questions.

11. Ease of use

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 11.1. The eModeration system is simple to use. | | | | | |
| 11.2. I don't notice any inconsistencies as I use the eModeration system | | | | | |
| 11.3. Whenever I make a mistake when using the eModeration system, I recover quickly and easily. | | | | | |
| 11.4. It is easy to find the information that I need. | | | | | |

12. Effectiveness

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 12.1. The eModeration system helps me to be more effective in completing the moderation. | | | | | |
| 12.2. The eModeration system helps me to be more productive. | | | | | |
| 12.3. The eModeration system meets my moderation needs. | | | | | |
| 12.4. The eModeration system has all the required functionality to conduct moderation processes. | | | | | |

13. Efficiency

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 13.1. The eModeration system saves me time when I use it. | | | | | |
| 13.2. Using the eModeration system is effortless. | | | | | |
| 13.3. The eModeration system does not require any unnecessary actions to accomplish what I want to do with it. | | | | | |
| 13.4. The eModeration system facilitates a faster transfer of files. | | | | | |

14. Satisfaction

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 14.1. I am satisfied with the eModeration system interface. | | | | | |
| 14.2. I would recommend the eModeration system to other teachers. | | | | | |
| 14.3. The eModeration system works the way I want it to work. | | | | | |
| 14.4. I am satisfied with the functionality provided by the eModeration system. | | | | | |

15. Learnability

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 15.1. I learned to easily navigate between the different screens of the eModeration system. | | | | | |
| 15.2. I easily remember how to use the eModeration system. | | | | | |
| 15.3. It is easy to learn to use the different functions of the eModeration system. | | | | | |
| 15.4. I learned to use the eModeration system quickly. | | | | | |

16. Flexibility

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 16.1. The eModeration system is flexible. | | | | | |
| 16.2. I can access files and/or feedback using any device. | | | | | |
| 16.3. I can use the eModeration system to upload/ download files easily. | | | | | |
| 16.4. I can use the eModeration system as a teacher or a moderator. | | | | | |

17. Information quality

| | Strongly disagree | Disagree | Neutral | Agree | Strongly agree |
|---|---|---|---|---|---|
| 17.1. The information (such as online help, on-screen messages, and other documentation) provided with this system is clear. | | | | | |
| 17.2. The eModeration system provides error messages that clearly indicate how to fix problems. | | | | | |
| 17.3. The organization of information on the system's screens is clear. | | | | | |
| 17.4. The information provided with the system assists me in completing my work. | | | | | |

Section C: User Experience

The following questions assess your user experience of the eModeration system. The questions consist of pairs of contrasting attributes that may apply to the eModeration system. The circles between the attributes represent gradations between the opposites. You can express your agreement with the attributes by selecting the circle that most closely reflects your impression. Please decide spontaneously to accurately convey your original impression.

Sometimes you may not be completely sure about your agreement with a particular attribute, or you may find that the attribute does not apply completely to the eModeration system. Nevertheless, please select a circle in every line.

| It is your opinion that counts. Please remember there is no wrong or right answer! | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |
| 18.1. | annoying | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | enjoyable |
| 18.2. | not understandable | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | understandable |
| 18.3. | creative | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | dull |
| 18.4. | easy to learn | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | difficult to learn |
| 18.5. | valuable | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | inferior |
| 18.6. | boring | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | exciting |
| 18.7. | not interesting | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | interesting |
| 18.8. | unpredictable | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | predictable |
| 18.9. | fast | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | slow |
| 18.10. | inventive | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | conventional |
| 18.11. | obstructive | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | supportive |
| 18.12. | good | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | bad |
| 18.13. | complicated | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | easy |
| 18.14. | unlikable | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | pleasing |
| 18.15. | usual | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | leading edge |
| 18.16. | unpleasant | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | pleasant |
| 18.17. | secure | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | not secure |
| 18.18. | motivating | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | demotivating |
| 18.19. | meets expectations | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | does not meet expectations |
| 18.20. | inefficient | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | efficient |
| 18.21. | clear | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | confusing |
| 18.22. | impractical | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | practical |
| 18.23. | organized | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | cluttered |
| 18.24. | attractive | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | unattractive |
| 18.25. | friendly | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | unfriendly |
| 18.26. | conservative | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | ☐ | innovative |

| Section D: General |
|---|
| 19.1. What challenges did you experience when using the eModeration system? |
| 19.2. What are your overall impressions of the eModeration system? |
| 19.3. What did you like the most about the eModeration system? Why? |
| 19.4. What did you like the least about the eModeration system? Why? |
| 19.5. Would you use an eModeration system to manage your moderation submissions and processes during the normal course of the assessment cycle? Please provide a reason. |
| 19.6. What features would make you likely to use this eModeration system more? Please provide a reason. |

## Appendix F: Focus group questions

Focus group with different faculties **after interaction** with the prototype:

**1. GENERAL**

❖ UX is defined by the ISO as the "user's perceptions and responses resulting from the use and/or anticipated use of a product, system, or service" (ISO-IEC, 2018). Users' emotions, physical and psychological responses, and internal and physical state resulting from previous experiences and user skills, amongst others, are included as part of this definition (Díaz-Oreiro et al., 2019).

1.1. Comment on your experience of interacting with the prototype. (user experience)

1.2. What aspects of the functionality can be improved or what can be included to make the system more functional? (task requirements)

1.3. What tasks were you not able to do? (task requirements)

1.4. What aspects do you believe are important to enhance the user experience of the system?

1.5. What are the general factors that will influence your decision to use an eModeration system?

1.6. Within your specific context and the tasks that you are required to carry out during the assessment cycle,

(a) What specific personal characteristics, needs, wants and skills do you believe will have an impact on your decision to use an eModeration system?

(b) What impact do the identified personal characteristics have on your adoption decisions?

2. **HEDONIC QUALITIES**

❖ Aesthetic experience aspects concern a product's ability to enhance user sensory modalities such as: look and feel of the product, colours, font, graphics and sounds used.

2.1. Considering the context of use and the tasks that you need to carry out during the assessment cycle, how important are:

(a) the aesthetics of the system?

(b) the aesthetics vs the productivity and functionality of the system (do goals)

2.2. To what extent will the aesthetics / visual appeal of the eModeration system influence your decision to use the system? (system affecting UX)

❖ Hedonic attributes or hedonic perception refers to the system's ability to satisfy the non-task-related needs of the user (Hassan & Galal-Edeen, 2017). The focus of hedonic perception is on the user. The hedonic quality of a system refers to an assessment of a system's ability to support the realisation of ''be-goals" (for instance an increase of knowledge and skills) for the user.

2.3. What are the "be" goals that you think an eModeration system should fulfil?

2.4. How important are hedonic attributes in your engagement with the eModeration system?

**3. LEARNABILITY AND FLEXIBILITY**

- ❖ Learnability: the time and effort necessary to attain a specific level of system performance while achieving specified goals in a specified context of use.

3.1. What are the specific attributes of the prototype that hampered/enhanced your learnability of the system

- ❖ Flexibility: degree to which the system can adapt to changes required by users.

3.2. To what degree was the eModeration system flexible/inflexible?

3.3. How important is flexibility in the moderation context?

3.4. What are the aspects that can be added to improve the flexibility?

4. Although currently available applications eg google drive, email, etc. are being used for moderation, what are the benefits/advantages of having a dedicated portal?

5. How important is it that the system should be novel?

6. How important is it that the system should be stimulating?

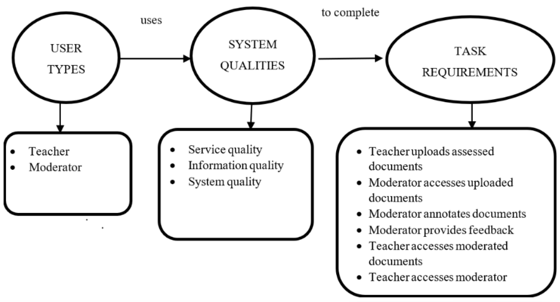
# Appendix G: Expert interviews to evaluate framework

## a) Information sheet for expert interviews

The purpose of the eModeration evaluation framework is to guide planning efforts during the development and implementation of eModeration innovations in the secondary school environment. The framework will be used to:

1. Provide guidance during the development of an eModeration system including an evaluation of the developed eModeration system (pre-usage) so that developers know what stakeholders will require from an eModeration system.
2. Evaluate eModeration system requirements when management or the ICT department want to evaluate an existing commercial system for purchase (pre and post-usage).

The components of an evaluation framework are the user, the system and the task.




The constructs of the user experience of an eModeration system to be evaluated are:

1. Usability: how easily and effectively users can use the eModeration system's functionality.
2. Hedonic qualities: personal and system characteristics that could impact user satisfaction with the use of the eModeration system.

User experience = usability + hedonic qualities

| Usability constructs (pre- and post-usage) | |
|---|---|
| Effectiveness | Accuracy and completeness with which users complete goals. |
| Efficiency | The optimal use of resources when using the system. |
| Satisfaction | Positive responses when using the system. |
| Learnability | How easy it is to learn to use the system. |
| Flexibility | The extent to which the system can accommodate to changes required by the user. |

| Hedonic qualities (post-usage) | |
|---|---|
| Self-efficacy | A judgement of the user's capability in using the eModeration system. |
| User preferences | Tailoring the eModeration system to meet individual requirements. |
| Training and experience | The amount of training and experience in the use of the system that will enable the user to be confident in its use. |
| Aesthetics | Visual appeal of the eModeration system. |

b) **Interview questions**

The evaluation criteria used in this interview are explained as follows:

- **Utility** – Determines how well the evaluation framework can be applied to evaluate a potential eModeration system.
- **Completeness** – The eModeration evaluation framework is complete when it addresses all or most aspects of the problem in an unambiguous and clearly understandable way.
- **Simplicity** – The framework is simple when different types of users can easily apply the framework to evaluate an eModeration system.
- **Generality** – If the framework broadly addresses the goal, i.e., the framework should address various modifications or adaptations of the eModeration system then it the criterion of generality is satisfied.
- **Parsimony** – When the framework fulfils its purpose without any unnecessary information being added.
- **Clarity** – the purpose of all components and operations of the framework and the interaction between components is evident.

1. The framework identifies the user, the task, and the system as components of an evaluation framework for an eModeration system.
   1.1. Do you think these components are relevant to a User Experience Evaluation Framework for eModeration?
   1.2. Please indicate if you would include additional components and motivate where possible.
   1.3. Please indicate if some of the components should be removed. Motivate where possible.

2. **Utility** – Determines how well the evaluation framework can be applied to evaluate a potential eModeration system.
   2.1. Please comment on the evaluation framework's ability to satisfy its main purpose.
   2.2. Please justify whether you believe the evaluation framework will work in evaluating an eModeration system to be used in the secondary school environment.
   2.3. What (if any) criteria could be included to add to the functionality of the evaluation framework?
3. **Completeness**
   3.1. Do you think the evaluation framework includes all required criteria?
   3.2. Please substantiate your answer based on the following components.
      3.2.1. User components
      3.2.2. Task components
      3.2.3. System components
   3.3. If not: what criteria would you add to the evaluation framework for eModeration and under which component?
4. **Simplicity**
   4.1. Is the evaluation framework simple enough for users to understand the criteria?
   4.2. If not, please indicate how the framework can be improved.
5. **Generality** - The framework has been developed to specifically evaluate electronic moderation systems for use in private secondary schools.
   5.1. Do you believe that public secondary schools or other organizations could benefit from using the evaluation Framework for eModeration?
   5.2. Please motivate your response if possible.
6. **Parsimony**
   6.1. Can the framework be used to evaluate an eModeration system with no unnecessary steps?
   6.2. Do you recommend any changes to the criteria to improve the parsimony of the framework?
7. **Clarity**
   7.1. Do you believe that the pre-usage criteria of the evaluation framework are clear? Please motivate your response.

7.2. Do you believe that the post-usage criteria of the evaluation framework are clear? Please motivate your response.

8. The constructs of usability in the User Experience Evaluation Framework for eModeration are identified as effectiveness, efficiency, satisfaction, learnability, and flexibility.
    8.1. Comment on whether you would recommend the inclusion of additional constructs.
    8.2. Comment on whether you would recommend the exclusion of any of the identified constructs.

9. The criteria for hedonic qualities (users' subjective reactions) in the evaluation framework are identified in table 1 of post-usage criteria.
    9.1. Comment on whether you would recommend the inclusion of additional criteria.
    9.2. Comment on whether you would recommend the exclusion of any of the identified criteria.

10. How can the evaluation framework be improved?

# Appendix H Unisa Ethics Approval

UNISA university of south africa

**UNISA COLLEGE OF SCIENCE,ENGINEERING AND TECHNOLOGY ETHICS REVIEW COMMITTEE**

2021-10-05

ERC Reference # : 2021/CSET/SOC/071
Name : V Rajamany
Student #: 07232969
Staff #:

Dear V Rajamany

**Decision: Ethics Approval from 2021/10/05 for five years**

**Researcher(s):** V Rajamany; 7232969@mylife.unisa.ac.za; +27 716797271

**Supervisor (s):** Dr C van Staden; Vstadcj1@unisa.ac.za; 0116709429

Prof JA van Biljon; judyvanbiljon@gmail.com; 0822534327

**Working title of research: A framework for evaluating the user experience of digital moderation systems in the South African secondary school environment: a participatory design approach.**

**Qualification:** PhD (Information Systems)

Thank you for the application for research ethics clearance by the Unisa College of Science, Engineering and Technology Ethics Review Committee for the above-mentioned research. Ethics approval is granted for 5 years.

*The **low risk application** was **reviewed** by the College of Science, Engineering and Technology (CSET) Ethics Review Committee on 2021-10-05 in compliance with the Unisa Policy on Research Ethics and the Standard Operating Procedure on Research Ethics Risk Assessment. The decision will be tabled at the next Committee meeting for ratification.*

The proposed research may now commence with the provisions that:

1. The researcher(s) will ensure that the research project adheres to the values and principles expressed in the UNISA Policy on Research Ethics.
2. Any adverse circumstance arising in the undertaking of the research project that is relevant to the ethicality of the study should be communicated in writing to the College of Science, Engineering and Technology (CSET) Ethics Review Committee.
3. The researcher(s) will conduct the study according to the methods and procedures set out in the approved application.

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4. Any changes that can affect the study-related risks for the research participants, particularly in terms of assurances made with regards to the protection of participants' privacy and the confidentiality of the data, should be reported to the Committee in writing, accompanied by a progress report.
5. The researcher will ensure that the research project adheres to any applicable national legislation, professional codes of conduct, institutional guidelines and scientific standards relevant to the specific field of study. Adherence to the following South African legislation is important, if applicable: Protection of Personal Information Act, no 4 of 2013; Children's act no 38 of 2005 and the National Health Act, no 61 of 2003.
6. Only de-identified research data may be used for secondary research purposes in future on condition that the research objectives are similar to those of the original research. Secondary use of identifiable human research data require additional ethics clearance.
7. No field work activities may continue after the expiry date (2026/10/05). Submission of a completed research ethics progress report will constitute an application for renewal of Ethics Research Committee approval.

*Note:*

*The reference number 2021/CSET/SOC/071 should be clearly indicated on all forms of communication with the intended research participants, as well as with the Committee.*

Yours sincerely,

HH Lotriet

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Chair of the Department of Information Systems Ethics Review Subcommittee
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