

**Exploring a Digital Pedagogy Framework that Embeds an Interactive E-
Book for Arabic as a Foreign Language Instruction**

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This thesis results entirely from my own work and has not been offered previously for any other degree or diploma. I declare that the word length conforms to the permitted maximum (49,514 words).

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Abstract

This design-based research (DBR) study addresses the lack of script-sensitive digital pedagogy for Arabic as a foreign language (AFL), focusing on the acquisition of Arabic writing systems by non-native learners in higher education. Motivated by the scarcity of appropriate digital tools and mixed evidence regarding e-books in Arabic contexts, the project developed, implemented, and iteratively refined the Alif Ba'a interactive e-book. The study employed a sequential exploratory mixed-methods design within the DBR. Cycle 1 involved exploratory focus groups with AFL teachers to identify classroom challenges and the desired characteristics of the tools. Cycle 2 consisted of semi-structured interviews with teachers and focus groups with students following prototype use, highlighting usability and pedagogical issues. Cycle 3 deployed adapted Technology Acceptance Model (Davis et al., 1989) surveys examining perceived usefulness (PU), ease of use (PEOU), behavioural intention (BI), and constructs including compatibility, media richness, and interactivity.

Qualitatively, teachers' and students' findings revealed recurrent challenges in online alphabet instruction, including letter-formation guidance, timely feedback, pronunciation modelling, and sustained engagement, specifying design requirements such as multimodal cues, guided letter formation, immediate feedback, concise task instructions, right-to-left interface alignment, and offline resilience. Iterative revisions addressed these issues. Quantitatively, teachers and students reported high PU, PEOU, and BI for the refined e-book. Teachers endorsed audio and interactive components as effective for beginners, while students expressed strong intentions to continue using and recommending the tool, noting minor workflow frictions.

The study makes three research contributions: (i) it proposes a digital pedagogy framework aligning cognitive task design—guided by Passey's Learning Elements Framework (2011) and Widyantoro's (2018) Presentation-Practice-Production approach—with acceptance constructs critical to adoption; (ii) it offers an empirically derived set of design principles for Arabic script e-books; and (iii) it provides evidence from iterative authentic classrooms across iterative cycles. These outcomes establish a replicable DBR pathway for developing script-specific digital interventions and practical guidance for integrating e-books into AFL curricula, advancing evidence-informed digital pedagogy.

Keywords: Arabic as a foreign language pedagogy, e-book, interactive exercises, design-based research, learning elements framework, technology acceptance model

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List of Abbreviations

Abbreviation	Full term
AFL	Arabic as a Foreign Language
ATU	Attitude Toward Using (TAM)
BI	Behavioural Intention
CALL	Computer-Assisted Language Learning
COVID-19	Coronavirus Disease 2019
DAISY	Digital Accessible Information System
DBR	Design-Based Research
DIT	Diffusion of Innovations Theory
DRM	Digital Rights Management
EBLL	E-Book-Based Language Learning
EFL	English as a Foreign Language
EPUB	Electronic Publication
ERIC	Education Resources Information Centre
GIF	Graphics Interchange Format
ICU-E	Intention to Continue Using E-books
IDLLF	Alif's Digital Language Learning Framework
IEEC	Interactive E-book Evaluation Criteria
IRB	Institutional Review Board
LEF	Learning Elements Framework
MALL	Mobile-Assisted Language Learning
MRT	Media Richness Theory
NVivo	Qualitative data analysis software
PBC	Perceived Behavioural Control
PDF	Portable Document Format
PEOU	Perceived Ease of Use
PPP	Presentation–Practice–Production
PU	Perceived Usefulness
RQ	Research Question(s)
SAT-E	Satisfaction with E-book Use
SN	Subjective Norms
SPSS	Statistical Package for the Social Sciences
TA	Thematic Analysis
TAM	Technology Acceptance Model

Abbreviation	Full term
TAM2	Technology Acceptance Model 2
TAM3	Technology Acceptance Model 3
TELL	Technology-Enhanced Language Learning
TPB	Theory of Planned Behaviour
TRA	Theory of Reasoned Action
UTAUT	Unified Theory of Acceptance and Use of Technology
USA	United States of America
WAI	Web Accessibility Initiative

Chapter 1: Introduction

1.1 Chapter Overview

This chapter introduces a design-based investigation for developing an interactive e-book¹ for teaching the Arabic writing system in a higher education Arabic as a Foreign Language (AFL) context. It outlines the background and problem, states the purpose and aims, presents the research questions (RQs), summarises the methodological and theoretical orientations, explains the study's significance, and maps the thesis structure.

The research highlights a significant gap in digital tools for learning Arabic script, which poses unique challenges compared to Latin scripts. As the digital landscape in education rapidly evolves, there remains limited research on how theoretical frameworks can inform the design of interactive electronic books (e-books) for Arabic script instruction. This study employs a design-based research (DBR) methodology across multiple iterative cycles to develop, implement, and evaluate the Alif Ba'a interactive e-book, using Passey's Learning Elements Framework (2011), the Technology Acceptance Model (TAM) (Davis et al., 1989), the Presentation–Practice–Production (PPP) approach (Widyantoro, 2019), and established Interactive E-book Evaluation Criteria (IEEC) (Bozkurt & Bozkaya, 2015). The investigation explicitly examines how the e-book's design affects Perceived Usefulness (PU), Perceived Ease of Use (PEOU), and Behavioural Intention (BI) among AFL teachers and students. By addressing both pedagogical and technological dimensions of digital language learning tools, this research makes a significant contribution to knowledge through the innovative integration of multiple conceptual frameworks within the DBR methodology. The chapter concludes with a roadmap of the thesis, which systematically presents the literature review, theoretical framework, research design, findings from each DBR cycle, discussion, and conclusions.

¹ <https://alifbaa.kotobee.com>

1.2 Background and Context

Digital texts have transformed the ecology of language learning. A considerable body of research suggests that e-books are practical and accessible, expanding learners' access to content relative to printed texts (Rao, 2003; Yaya, 2015). The rise of mobile technologies has further amplified these benefits through Mobile-Assisted Language Learning (MALL), where smart devices support instant electronic feedback, audio-visual materials, and game-like activities that augment the language learning potential of digital books (Zhang et al., 2020). Studies have documented positive effects: improved social skills, attention, and literacy in early readers, as well as heightened engagement when peer feedback is embedded in interactive e-books (Asrowi & Hanif, 2019; Ebied & Rahman, 2015; Hwang & Wang, 2018; Yow & Priyashri, 2019). In the English as a Foreign Language context, interactive e-books have facilitated collaboration and supported gains in reading comprehension and performance (Alsofyani, 2019).

Some learners express no clear preference for e-books over print (Ebied & Rahman, 2015), and others prefer printed books (Woody et al., 2010). Experimental work has also reported equivalent effects on reading accuracy when comparing e-books to traditional books (Huang et al., 2012). At the same time, the learning affordances of e-books continue to motivate educators to report improved outcomes relative to conventional textbooks (Golonka, 2014; Korat & Falk, 2017; Wu & Chen, 2018). In recent syntheses, e-books are described as reshaping educational experiences by enabling interactive, engaging content (Dahlan et al., 2024), with specific potential for Arabic, particularly through interactive exercises that aid vocabulary, pronunciation, and reading (Erradi et al., 2012; Trigui et al., 2012).

For Arabic, however, the promise of multimedia has not yet been fully translated into robust pedagogical support. While audio-visual features can assist pronunciation (Erradi et al., 2012), the fine-grained phonological awareness needed for Arabic—such as emphatic consonants and vowel length—remains under-supported by current tools. This gap reinforces calls for Arabic-specific auditory scaffolding (Trigui et al., 2012). It highlights a broader disconnect between the theoretical affordances of rich media and their practical application

in script instruction (Daft et al., 1987). These observations sit within a larger landscape in which user acceptance is decisive; the willingness of students and teachers to use a technology is a critical success factor that shapes whether innovations translate into meaningful classroom impact (Bano & Zowghi, 2015; Carreño & Winbladh, 2013; Taherdoost, 2018).

Arabic is spoken by more than 422 million people across the Arab world and in non-Arab contexts such as Turkey, Malaysia, and parts of Iran (United Nations, n.d.). Its political and economic status is increasing (Bassiouney & Katz, 2012) and fuels student demand for Modern Standard Arabic and colloquial varieties. However, research focused on university students remains scarce and encounters distinct challenges due to the complexities of the Arabic script and the issue of diglossia, where two different, but related, varieties of the same language coexist within a community, each serving a specialised function (Ferguson, 1959). In addition, Arabic is categorised into three varieties (Elgibali, 2005): Classical Arabic (CA), Modern Standard Arabic (MSA), and colloquial dialects. Because this case complicates instruction, this thesis concentrates on the Arabic alphabet in CA and MSA. In principle, interactive e-books align well with AFL: audio, video, and structured interactivities can support vocabulary learning, pronunciation, and comprehension of written texts (Erradi et al., 2012). Arabic's diglossic and complex writing system—cursive letter forms conditioned by position, dense diacritic systems, and phonological contrasts such as emphatic consonants and vowel length—impose perceptual-motor and cognitive demands that are not directly comparable to those of Latin scripts (Wiley & Rapp, 2019). Available applications tend to privilege general usability and engagement over systematic alignment with script-specific objectives and are seldom grounded in coherent design frameworks (Chen et al., 2023; Wiley & Rapp, 2019). Crucially, the fine-grained auditory scaffolding needed for phonological sensitivity remains weak, revealing a persistent gap between the theoretical affordances of rich media and their practical deployment in script instruction.

The present project underscores the urgent need for script-sensitive digital tools in higher education. First, higher education remains under-researched, given distinct learner profiles and curricular aims (Alhammad, 2017; Dalton, 2014; Nishat & Islam, 2015). Second, AFL's

script-specific demands necessitate a theoretically grounded, script-sensitive tool that targets the perceptual, motoric, and cognitive aspects of alphabet acquisition (Wiley & Rapp, 2019). Third, acceptance must be measured from the outset so that PU and PEOU inform iterative refinement (Davis, 1989; Davis et al., 1989). Accordingly, this study integrates LEF, PPP, and IEEC into a coherent design for an interactive AFL e-book, employing TAM to evaluate user acceptance. The work is situated within a higher-education, multi-site ecology centred on a United States (US) branch campus in the Gulf (Site A), with collaboration involving a national public university in Qatar (Site B), a research university in the USA (Site C), a USA liberal arts college (Site D), a European research university (Site E), and a Canadian educational institute (Site F). The accelerated adoption of blended models amplifies the need for practical script-sensitive tools preserving pedagogical integrity.

In sum, digital texts expand access and engagement, but Arabic teaching and learning reveal the limits of general-purpose solutions. Interactive e-books can motivate, scaffold, and improve outcomes; however, their effects vary and hinge on design quality, alignment with script-specific objectives, and contextual fit. A critical response, therefore, centres on a theoretically informed, acceptance-aware, script-sensitive design—translating the promise of Technology-Enhanced Language Learning (TELL) and Mobile-Assisted Language Learning (MALL) into robust learning experiences for beginning Arabic script within higher education.

1.3 Problem Statement

In my teaching practice as an AFL educator, I encounter context-specific barriers that hinder the effectiveness of digital integration. While broader language education has transitioned from Computer-Assisted Language Learning (CALL) to TELL and MALL (Marriott & Torres, 2009), my classroom experience reveals challenges: the pace of innovation burdens institutions to master evolving tools (Healey et al., 2008); insufficient support and teacher training impede utilisation (Crompton, 2017); and the scarcity of ‘suitable’ resources became evident during the pandemic. My analysis of Arabic-language apps confirm a deficit, with most tools targeting native-speaking children featuring Arabic-only interfaces. As Essam

(2019) observes, inadequate support remains a barrier to TELL – necessitating “user-friendly [interfaces] that allow teachers and students to focus on the activity and not on the technical complexities” (p. 166).

The scarcity and unsuitability of existing digital tools for AFL learners were critically exposed during remote learning prompted by the COVID-19 pandemic. Analysis reveals a stark paucity of applications specifically designed for adult AFL learners at the university level. A scrutiny of Arabic alphabet mobile applications on the Apple App Store revealed that only two out of 45 applications were suitable; the remainder targeted Arabic-speaking children with interfaces that were solely in Arabic, rendering them inaccessible pedagogically. This acute unavailability highlights a systemic failure to develop resources tailored to the specific cognitive and linguistic needs of non-native speakers.

These practical impediments intersect with profound theoretical and research deficiencies. Despite the proliferation of e-books, significant gaps persist in their design and adoption for AFL. Firstly, dedicated AFL research is limited, often focusing on general language learning rather than the unique challenges of Arabic, such as letter complexity and diacritic integration, which significantly impact perceptual learning. Secondly, a persistent mismatch exists between the theoretical affordances of media-rich environments and the practical implementations that address Arabic’s nuanced phonological and orthographic features. Consequently, while educational technology proliferates, its effective adoption in AFL remains limited. The field lacks robust, customisable tools designed for adult AFL learners and practitioners. Therefore, this study directly addresses these gaps. It investigates teacher and student perceptions to inform the development of a practical, interactive e-book application for Arabic writing instruction, which can be used both synchronously and asynchronously. Simultaneously, it aims to propose a new theoretical model to guide future designers and researchers in creating effective, contextually relevant digital AFL resources, moving beyond the current limitations observed in practice.

1.4 Purpose and Aims

The study and thesis pursue a clear purpose: to design, implement, and iteratively refine an

interactive e-book that supports university-level learners of AFL in mastering the Arabic writing system, while proposing a transferable digital-pedagogy framework for AFL. This purpose is operationalised within a DBR methodology that integrates theory and practice across iterative cycles in authentic settings. Passey's framework (2011) guides task design to ensure balanced attention to cognitive, affective, and social dimensions, and learning sequences are structured through a PPP approach (Widyantoro, 2019). In combination, these choices position the project to yield both a concrete instructional intervention and generalisable design principles for AFL digital pedagogy, including attention to recognised IEEC (Bozkurt & Bozkaya, 2015).

Aligned with this purpose, the study investigates teachers' and students' acceptance of the e-book through the TAM, focusing on PU, PEOU, and BI, while also attending to selected external (e.g., compatibility, accessibility, social influence) and internal (e.g., self-efficacy, enjoyment, satisfaction) variables highlighted in prior adoption research (Davis, 1989; Venkatesh & Davis, 2000; Venkatesh et al., 2003). The study contributes a digital-pedagogy framework for AFL by integrating theoretical and design criteria and articulating design principles from iterative implementation cycles, thereby linking the intervention's design, its evaluation, and the study's overarching RQs.

1.5 Research Questions

This thesis is guided by RQs exploring the development, evaluation, and acceptance of an interactive e-book for AFL instruction. These are divided into overarching inquiries and specific questions aligned with the three cycles of the DBR methodology.

Overarching questions:

What are the design characteristics of an interactive e-book that enhance AFL teaching and learning of the Arabic writing system?

How does the design of the AFL e-book affect PEOU, PU, attitudes, and BI to use it?

Specific DBR cycle questions:

DBR Cycle 1 (Exploratory — teachers)

RQ1: What challenges are encountered in teaching the Arabic writing system?

RQ2: What digital tool characteristics would be ideal for addressing these challenges when teaching the Arabic writing system?

DBR Cycle 2 (Qualitative — teachers and students)

RQ3: What are AFL teachers' perceptions of using the interactive e-book to teach the Arabic writing system?

RQ4: What teacher challenges are reported in relation to the e-book's PEOU and PU?

RQ5: What are AFL students' perceptions of using the interactive e-book to learn the Arabic writing system?

RQ6: What student challenges are reported in relation to the e-book's PEOU and PU?

DBR Cycle 3 (Quantitative — acceptance)

RQ7: To what extent do PEOU and PU influence students' behavioural intentions to adopt the interactive e-book?

RQ8: To what extent do PEOU and PU influence teachers' behavioural intentions to adopt the interactive e-book?

These questions connect design, user experience, and adoption. They allow the thesis to specify and justify design decisions, gather stakeholder feedback to improve the intervention, and model acceptance dynamics based on established theory. This creates a clear path from needs analysis through intervention evaluation to theory-based adoption analysis.

1.6 Significance and Contributions

This thesis is significant because it tackles a well-documented practical and methodological gap in AFL by designing and evaluating a script-focused interactive e-book through a DBR methodology. It integrates four frameworks—Passey’s LEF (2011), PPP (Widyantoro, 2019), TAM (Davis et al., 1989), and Bozkurt and Bozkaya’s IEEC (2015) —to align cognitive demands of Arabic script acquisition with user acceptance constructs (PU/PEOU), thereby translating theory into concrete design decisions and bridging the persistent divide between innovation and effective classroom practice. By situating the work in authentic AFL settings and iterating the design with stakeholders, DBR is used as a systematic yet flexible methodology to produce contextually sensitive design principles and theory, while directly addressing the lack of robust digital tools and pedagogies for teaching the Arabic alphabet.

The thesis contributes at three levels. Theoretically, it demonstrates how the four frameworks interact productively to scaffold learning and engagement, while empirically validating Bozkurt and Bozkaya’s criteria for integrity, coherence, and connectivity in AFL e-book design. Practically, it offers a replicable, low-cost blueprint for multi-platform e-books (e.g., via Book Widgets) and provides evidence-based guidance on visual supports, interactivity, and information density to avoid cognitive overload. It also derives policy-relevant insights into the time-intensive nature of meaningful digital pedagogy. Methodologically, it shows the value of DBR for small-cohort language courses and a sequential mixed-methods triangulation that links qualitative insight to quantitative instrument development, thereby generating design principles grounded in real-world use. Collectively, these contributions provide a framework and methodology for developing digital resources that are both technologically robust and pedagogically sound in AFL and cognate non-Latin script contexts.

1.7 Structure of the Thesis

The thesis is structured to progress from context and theory to design and methodology, ultimately leading to empirical findings and their implications, in accordance with the DBR cycle. It consists of eight chapters, followed by the References and Appendices sections. The

layout is shown in Table 1.

Chapter	Focus / Contents
Chapter 1 – Introduction	Background, problem, aims, research questions, significance, and an overview of the thesis structure.
Chapter 2 – Literature Review	Evidence on e-book adoption/effectiveness (esp. in higher education), acceptance models, and gaps specific to AFL.
Chapter 3 – Conceptual Frameworks	The four guiding frameworks (LEF, TAM, PPP, Bozkurt & Bozkaya) and how they inform the e-book's design; brief e-book overview.
Chapter 4 – Research Methodology	Rationale for DBR, its characteristics and phases in this study, mixed-methods design, researcher roles, ethics, and limitations.
Chapter 5 – Data Collection and Analysis	Sequential exploratory mixed-methods across the three DBR cycles; instruments, procedures, and analysis plan.
Chapter 6 – Results	Findings per research question and DBR cycle; synthesised qualitative themes and quantitative acceptance outcomes.
Chapter 7 – Discussion and Implications	Interpretation against the frameworks; implications for AFL pedagogy and interactive e-books; addressing earlier gaps.
Chapter 8 – Conclusion	Contributions, limitations, and directions for future/longitudinal research and scaling beyond the alphabet.

Table 1: Structure of the Thesis

Chapter 2: Literature Review

2.1 Introduction

A considerable amount of literature has been published on the educational impact of using e-books in teaching and learning. These studies postulate that e-books are more practical and accessible than printed books, given how they increase access to content and information (Rao, 2003; Yaya, 2015) when using mobile technologies for language learning. Smart mobile devices now feature instant electronic feedback, audio-visual elements, and games that enhance digital books for language learning (Zhang et al., 2020, p.108).

However, the relative importance of e-books has been a subject of considerable discussion due to contradictory findings. Some studies have shown that e-books improve learners' social skills, enhance children's attention and literacy, and increase student engagement through peer feedback in interactive e-books (Asrowi & Hanif, 2019; Ebied & Rahman, 2015; Hwang & Wang, 2018; Yow & Priyashri, 2019). Similarly, interactive e-books benefited English as a Foreign Language (EFL) student collaboration in reading comprehension and performance (Alsofyani, 2019). On the other hand, some studies have found that students have no preference for using e-books or printed books (Ebied & Rahman, 2015) or even prefer printed books (Woody et al., 2010). Another study found that e-books and traditional books have an equal effect on reading accuracy (Huang et al., 2012).

E-books have profoundly transformed education by providing learners with interactive and engaging content (Dahlan et al., 2024). E-books offer numerous opportunities to incorporate multimedia elements, including audio, video, and interactive exercises for learning Arabic. These features greatly enhance the learning experience, particularly in vocabulary acquisition, audio pronunciation, and understanding written Arabic texts (Erradi et al., 2012; Trigui et al., 2012).

E-books offer learners convenient access to current resources, free from the logistical constraints of traditional print books. Embracing technology has become vital for educators as institutions increasingly recognise e-books as valuable educational tools (Korat & Falk, 2017; Wu & Chen, 2018). Furthermore, digital tools like e-books are associated with

improved outcomes in foreign language learning, including enhanced language retention and greater learner motivation than conventional printed textbooks (Golonka, 2014).

2.2 Aim and Rationale of the Current Review

This literature review synthesises current scholarship on the adoption, efficacy, and use of e-books in Arabic language education from both student and teacher perspectives. It draws on the definition of a literature review as encompassing key themes, theories, and methods in the field (Creswell et al., 2003). It builds on this by interpreting data findings from collected research (Merriam & Simpson, 2000). The primary aim is to gather reliable studies addressing core RQs (Ryś et al., 2009) and lay a foundation for assessing relevance (Knopf, 2006). The review outlines the pedagogical benefits, challenges, and user preferences in e-book use, revealing gaps in acceptance and implementation among foreign language learners and educators. It examines factors shaping adoption and bridges the divide between theoretical affordances and practical applications. Ultimately, it equips educators, researchers, and policymakers with insight into optimising e-books for language acquisition and highlights areas needing further inquiry to unlock their full pedagogical potential.

2.3 Methods Used in this Review

This section describes the search strategies and criteria I used to identify potential studies for this review. This description will serve as a tool to examine whether prior studies on using interactive e-books in teaching and learning foreign languages were of use, with justifications for their use.

2.3.1 Search Strategy

The review adopted two strategies for locating relevant studies. Firstly, electronic library databases and e-journals provided primary sources. Secondly, a snowball sampling approach was used to reference additional resources included in each study.

This review includes recent peer-reviewed and scholarly sources published over the past eleven years, drawn from five online databases (Academic Search Premier, Education Research Complete, ScienceDirect, ProQuest Educational Journals, and ERIC), as well as

Google Scholar, which were initially searched. In addition, electronic library databases at Georgetown University and Lancaster University’s OneSearch were utilised.

To access relevant journal articles and databases, I used groupings of one or more of the following search terms: ‘Interactive e-book design’, ‘e-book design principles’, ‘e-book educational impact’, ‘e-book adoption’, ‘e-book acceptance’, ‘e-book perceptions’, ‘language teachers’ perceptions of the e-book’, ‘foreign language students’ perceptions of the e-book’, ‘expectation–confirmation’, and ‘e-book teaching and learning’.

2.3.2 Search Criteria

From this literature review search, a total of 863 articles were identified from online databases and electronic library databases. Seventy-six studies were also reviewed and referenced using and modifying a narrative synthesis approach proposed by McCutcheon et al. (2015). The search criteria also included key terms relevant to this review, presented in Table 2, drawn from their usage beyond common language (Locke et al., 2013).

Term	Concise definition	Key reference(s)
Electronic book (e-book)	Digitally delivered book read on computers/mobile devices; used here for teaching/learning in HE.	Letchumanan & Tarmizi (2013); Alhammad & Ku (2016).
Electronic textbook (e-textbook)	Course-aligned digital textbook, often with embedded study tools.	Hsiao & Tang (2014); Baker-Eveleth & Stone (2015).
Interactive e-book	E-book integrating multimedia and tasks (quizzes, feedback) to support learning—not just reading.	Bozkurt & Bozkaya (2015).
Interactive exercises	Purpose-built tasks with immediate feedback, sequenced by pedagogy (e.g., PPP) and learning elements (LEF).	Passey (2011); the PPP model used in Alif Ba'a.
Perceived Ease of Use (PEOU)	The degree to which using a system is free of effort.	Davis (1989).
Perceived Usefulness (PU)	The degree to which using a system enhances performance/learning.	Davis (1989).
Interface	The user-facing layer (layout, navigation, controls) of the e-book/reader.	Bozkurt & Bozkaya (2015); Kamarulzaman & Shaari (2015).

Term	Concise definition	Key reference(s)
Platform	The software environment delivering the e-book (e.g., reader app/LMS integration).	Bozkurt & Bozkaya (2015).
Multiplatform	Consistent operation across devices/OS (tablet, laptop, phone).	Bozkurt & Bozkaya (2015).
Customisation / Autonomy	Learner-controlled settings (e.g., font size, pacing) and personalised feedback that support self-regulation.	Kamarulzaman & Shaari (2015); Alhammad & Ku (2016).
Digital Rights Management (DRM)	Technical/licensing controls governing copying, printing, and sharing of e-book content.	Bozkurt & Bozkaya (2015).
Universal accessibility design	Design enabling equitable use (e.g., TTS, contrast, keyboard navigation), including for visual/reading impairments.	Al-Thani et al. (2019); Al-Wabil et al. (2006); Benaida (2014); Doush et al. (2014).
Online/Offline availability	Core functions are available without continuous connectivity, allowing for “anytime/anywhere” reading.	Luo et al. (2021).

Table 2: Key Terms

2.3.3 Inclusion and Exclusion Criteria

The selected articles were classified after screening against the inclusion/exclusion criteria adapted from the Joanna Briggs Institute data extraction form (Tufanaru et al., 2017), which was used to map the number of papers identified, included, and excluded, along with the reasons for exclusions in both qualitative and quantitative research. The following inclusion and exclusion criteria, as shown in Table 3, are utilised to link the RQs to the selected studies (Creswell et al., 2003).

	Inclusion criteria	Exclusion criteria
Type of studies	Empirical studies on e-books for teaching second languages, including perceptions of teachers and learners, and challenges in their use.	- E-books in university libraries. - Interactive e-books for tourism. - E-books for learners with disabilities and visual impairments.
Relevance to research questions	Studies that include the keywords relevant to the thesis research questions.	
Participants' education level	Tertiary-level students (post-secondary education). University-level students. Post-graduate learners.	Pre-school, primary, and secondary school/citizens who read E-books.

	Inclusion criteria	Exclusion criteria
Study designs	Experimental studies.	- Meta-analyses - Review studies - Studies from the author's PhD thesis
Disciplines	Learners of ESL, EFL, AFL, or ASL. Computer education. Teacher education.	- Journalism. - Libraries. - Information science.
Language	Journal articles that are written in English.	Journal articles that are written in a language other than English.
Availability of text	Full-text available.	Abstracts only papers. Unreachable papers.
Publication status	Published literature only.	Unpublished literature, duplicate studies, concept papers, and reviews.
Years of publication	From 2009 to 2024.	Before 2009.

Table 3: Inclusion and exclusion criteria

2.4 Describing the Selected Studies

Many studies have attempted to investigate the use of e-books in different disciplines and educational levels. The most common age group used e-books to promote children's vocabulary (Korat & Shneor, 2019; Lee, 2017, 2020; Wood et al., 2018). Several studies have been carried out investigating the effectiveness of e-books in teaching students ranging from preschool to secondary school, while exploring the perceptions and awareness of teachers and students towards the use of e-books (Ciampa, 2012; Huang et al., 2012; Lee, 2017; Shamir & Baruch, 2012; Wood et al., 2018).

The literature on users' perceptions has also highlighted another issue found in several studies focusing on the use of e-books in academic libraries and information science (Hoseth & McLure, 2012; Kiilu et al., 2020; Leonard & Snyman, 2019; Zhang, 2019). The transformation from printed books to digital books has been expanded gradually to replace printed books because of the erosion of book sales and publishers offering digital content (Chesser, 2011; Slater, 2010).

For this study, this review focuses on university-level students, a neglected group in the research literature. A small body of literature has been conducted in a limited number of areas

to explore university-level students' experiences using e-books (Alhammad, 2017; Dalton, 20; Nishat & Islam, 2015) Out of the 76 studies that focused on the use of e-books with tertiary and university-level students, 49 investigated e-books used in various majors, as shown in Table 4, while 12 journal articles examined e-book-based language learning (EBLL).

Context category	Count (N)	% of 76
Discipline-based majors (non-language)	49	64.5%
E-book-based language learning (EBLL)	12	15.8%
Libraries / Information Science & other HE contexts	15	19.7%
Total	76	100%

Table 4: Distribution of Empirical Research

2.4.1 Methods of Data Collection

Thirty-six studies frequently employed a quantitative design to collect data using a quantitative survey or online questionnaire, followed by seven studies that investigated users' perceptions or acceptance of e-books, as shown in Table 5.

Collecting Data Method	Number of Studies
Quantitative approach	36
Mixed-method approach	8
Qualitative approach	8
Quasi-experimental pre-test/post-test design	7
Online diaries reporting experiences with e-books	3
Think-aloud and qualitative approach	1

Table 5: Methods of Data Collection

In the quantitative approaches, paper-based questionnaires or online surveys were employed for three reasons. The first is the study design, where the authors collected data from a significant number of participants (an average of 671), ranging from 135 to 1,600. The second is the study location; data were obtained from various countries, universities (Cumaoglu et al., 2013; Smeda, 2017), or regions within the same country (Leonard & Snyman, 2019). Moreover, authors tended to use a quantitative data approach to investigate if there were significant correlational relationships or interrelationships between variables represented in their hypotheses (Chen, 2015; Maduku, 2015; Smeda, 2017). These relationships differed from those in the TAM, such as the connections between BI towards e-books and PEOU or

PU (Lai & Ulhas, 2012; Lawson et al., 2018; Ngafeeson, 2011). They also contrast with BI's relations to internal and external factors, such as gender, compatibility, accessibility, relative advantage, self-efficacy, subjective norms (SN), intention to continue using e-books, satisfaction with e-book use, age, and cost. Therefore, quantitative data were the most valued form that the authors of the selected papers used to decide whether to adopt e-books in academic disciplines.

The mixed-method approach and the quasi-experimental research design were the second most common methods for collecting data regarding e-book users' perceptions and acceptance. Eight studies employed mixed methods, combining quantitative and qualitative data collection methods, which included structured interviews, discussion groups, and focus groups—this combination of strategies aimed to understand the research problem (Creswell, 2013).

It is important to note that the standard data-collection methods in EBLL journal articles used a mixed-method approach in five studies, followed by the pre- and post-testing approach in four. Quantitative data collection methods were employed in two studies, and a qualitative data approach was used in one study. Additionally, three articles collected data using a qualitative approach, such as discussion groups, focus groups, or semi-structured interviews (Alhammad, 2017; Alhammad & Ku, 2016; Oyaid & Alshaya, 2019).

2.4.2 Methods of Data Collection

Across this review, twelve studies reported using the TAM as the primary theoretical framework. Eight studies utilised TAM (Bulur & Gönül, 2020; Chen, 2015; Jin, 2014; Liao et al., 2018; Ngafeeson, 2011; Pilco, 2017; Poon, 2014; Salloum & Shaalan, 2018; Smeda, 2017; Tri-Agif et al., 2016), while two studies used the extended TAM (Smeda et al., 2017; Ujakpa et al., 2019). Three other studies applied the unified theory of acceptance and use of technology (UTAUT) (Lawson-Body et al., 2018; Maduku, 2015; Yoo & Roh, 2019). Moreover, twenty-seven studies did not specify which theoretical or conceptual framework was adopted, as shown in Table 6.

Among the several studies investigating learners' acceptance of using e-books in higher

education, studies that employed TAM as a framework to examine the teachers’ acceptance and university-level students’ acceptance and use of e-books were beneficial in answering their first and second RQs. In addition to utilising TAM, these studies are relevant to my study and thesis regarding research methodology, participant type, and findings.

Theoretical Framework	Number of Studies
TAM	12
UTAUT	6
ETAM	2
No theoretical framework	27
E-book Use Model	1
Diffusion of Innovations Theory (DIT)	2
Information Processing Theory	1
Rauding theory derived from the words ‘reading’ and ‘auding’	1
Social Constructivism Social/Information Processing Theory/Self-efficacy as a subset of social cognitive theory	1
Uses and Gratifications Theory (UGT), Expectation Confirmation Theory (ECT), and Diffusion of Innovations Theory	1
Motivation theories	1
Reader-response theory	2
The interactionist theory/Cognitive information processing theory	1
Media richness theory (MRT, also known as the Information Richness Theory)	1

Table 6: Theoretical frameworks in the literature

However, other studies in this review answered the third research question concerning the challenges users face and the factors that influence the usage of e-books. For example, Lawson et al. (2018) and Yoo (2019) employed UTAUT to investigate the factors that impact learners’ acceptance of e-books (Lawson et al., 2018; Yoo, 2019), while Maduku (2015) utilised UTAUT as a lens to explore students’ BI. Furthermore, the current review of EBLL studies revealed that three journal articles employed the theoretical frameworks of reader-response (Chou, 2015), TAM and task-technology fit theory (Pilco, 2017), and the interactionist theory, constructivist learning approach, and cognitive information processing theory (Alsofyani, 2019).

2.5 Importance of the Users’ Acceptance

The success of new technologies hinges on user acceptance, defined as the willingness to use

technology for its intended tasks (Dillon, 2001). Therefore, understanding the factors influencing this acceptance is crucial for technology developers and decision-makers (Taherdoost, 2018). Users' satisfaction is essential, as their acceptance is considered a "critical success factor" (Bano & Zowghi, 2015). Collecting user feedback is vital for refining software quality and enhancing technology (Carreño & Winbladh, 2013).

Researchers have developed various theoretical frameworks to understand user acceptance of new technology. This will be explored further in the conceptual framework chapter. The Theory of Reasoned Action (TRA) by Fishbein and Ajzen (1980) outlines three cognitive elements: attitudes, social influence, and user intentions (Taherdoost, 2018). Ajzen (1991) expanded this with the Theory of Planned Behaviour (TPB) by adding the perceived behavioural control element, which reflects the resources, opportunities, and skills necessary for achieving a behavioural outcome (Gunasinghe et al., 2019; Tarhini et al., 2015).

While research has examined user acceptance of e-books, few studies have applied the TAM as a framework (Mizher & Alwreikat, 2023; Nazari & Abdekhoda, 2021; Salloum & Shaalan, 2018). The TAM identifies key variables that influence technology acceptance: a) PU, which Davis (1989) defines as "the degree to which a person believes that using a particular system would enhance his or her job performance" (p.320); and b) PEOU, defined as "the degree to which a person believes that using a particular system would be free of effort" (p.320). The other TAM concepts are defined as follows:

Behavioural intention is defined as "the degree of a person's willingness to use information technologies in the future" (Tsai, 2012, p.56).

Attitude towards use is defined as "the users' desirability to use the particular system/technology" (Malhotra & Galletta, 1999).

External variables are defined as "the factors that affect PU, PEOU, and attitude towards use (ATU)" (Phan & Daim, 2011).

The TAM assumes that user behaviour in adopting new technology is influenced by their BI, which is shaped by their attitude towards use and perceived utility of the technology (Dillon & Morris, 1996). The TAM explains user intention towards information systems through PU

and PEOU (Davis et al., 1989). Additionally, external variables affect PU, PEOU, and attitude towards use (Phan & Daim, 2011). Venkatesh and Davis (2000) emphasised that these external variables influence usage intention through PU and PEOU (Venkatesh & Davis, 2000, p.187) (see Figure 1).

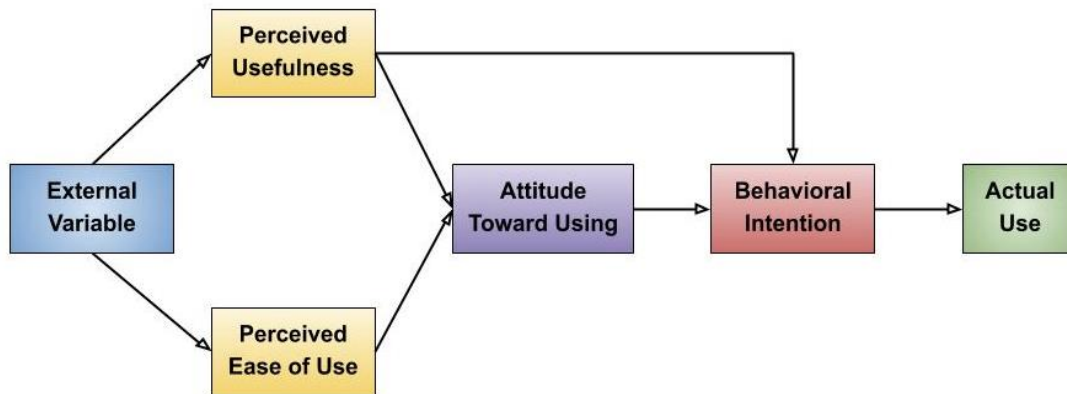


Figure 1: Technology Acceptance Model. Source: Davis et al. (1989, p.985)

2.5.1 User’s Acceptance of the E-book

Many recent studies (Bulur & Gönül, 2020; Elyazgi et al., 2015; Jin, 2014; Smeda, 2017) have explored how internal and external variables influence the acceptance and adoption of new technologies. The TAM explains the relationship between external factors that affect user acceptance and the factors that shape actual behaviour (Hong & Yu, 2018). External variables motivate students and teachers to adopt and use new technologies.

According to Hubona and Whisenand (1995), external variables include “individual variables (age, gender, education, cognitive abilities, computer anxiety, professional and computer experience), task variables (complexity), and organisational variables (user participation, involvement, organisational position, job role, and training)” (Hubona & Whisenand, 1995, p.23). Semda (2017) further defines extrinsic and intrinsic factors: extrinsic factors encompass technical service quality, library service quality, accessibility, cost, mobility, facilities, and social influence; and intrinsic factors include resistance to change, self-efficacy, and language (Semda, 2017, pp.22-23). Additionally, Chen (2015) identified

demographic variables—such as gender, level of education, and educational status—as influencing user behaviour. It is clear that the factors that emerged from this review are varied.

2.6 Key Factors Influencing E-learning Adoption

2.6.1 External Factors

The adoption of e-books in educational settings is shaped by external and internal factors influencing user acceptance and utilisation. As shown in Table 7, compatibility plays a significant role in adoption among the external factors. Studies by Jin (2014), Lai and Ulhas (2012), and Chau and Hu (2001) emphasise that compatibility with various devices, formats and platforms affects PU and intention to use. Additionally, accessibility is a key factor, as it addresses technological, cultural, and individual considerations. Innovations like Digital Accessible Information System (DAISY) formats (Doush et al., 2014), text-to-speech systems for Arabic (Al-Thani et al., 2019), and adherence to web accessibility standards (Boudhief et al., 2014) have significantly enhanced usability, especially for learners with special needs. Self-efficacy, or confidence in one’s ability to use e-books effectively, is a significant determinant of adoption, as demonstrated by Jin (2014), Smeda (2017), and Liao et al. (2018). Cultural and linguistic preferences, such as font types and culturally responsive design, further impact accessibility (Benaida, 2014).

External Factors	Description	References
Compatibility	Consistency of e-books with devices, formats, and platforms.	Chau & Hu (2001), Cheng (2015), Jin (2014), Lai & Ulhas (2012), Rogers (1995), Rogers (2003), Wu & Wang (2005).
Accessibility	Technological, cultural, and individual considerations affecting usability.	Al-Thani et al. (2019), Al-Wabil et al. (2006), Benaida (2014), Boudhief et al. (2014), Doush et al. (2014).
Cost	Financial implications of adopting e-learning tools.	Cheng (2015), Rogers (1995).
Subjective Norms	Societal and peer pressure to adopt e-learning systems.	Hussein (2018), Salloum & Shaalan (2019), Yau & Ho (2015).
Perceived Risk	Concerns about data privacy and system reliability.	Bulur & Gönül (2020), Teo et al. (2019).

External Factors	Description	References
Computer Self-Efficacy	Belief in one's ability to use e-learning tools effectively.	Cheng (2015), Jin (2014), Liao et al. (2018), Smeda (2017).
Technical Service Quality	Performance and reliability of the e-learning system.	Smeda (2017).
Library Service Quality	Support provided for accessing e-learning resources.	Smeda (2017).
Demographic Variables	Impact of gender, education level, and status on adoption.	Chen (2015).
Cultural Preferences	Influence of cultural norms, font types, sizes, and colours on usability.	Benaida (2014).

Table 7: External Variables Influencing E-learning and E-book Adoption

Other external variables include cost considerations, which have been shown to influence adoption decisions (Cheng, 2015; Rogers, 1995). Social influences, particularly from peers and instructors, are critical drivers of adoption (Hussein, 2018; Salloum & Shaalan, 2018; Yau & Ho, 2015). Furthermore, perceived risks, such as concerns about data privacy and system reliability, can act as a barrier to adoption (Bulur & Gönül, 2020). Additional factors like technical service quality, library service support (Smeda, 2017), and demographic variables (Chen, 2015) further shape users' decisions and perceptions of e-books as valuable alternatives to traditional textbooks.

In the following sub-sections, the literature review will concentrate specifically on the external factors of Compatibility, Accessibility, SN, and Cultural Preferences. These factors were chosen for their relevance in analysing the acceptance of the Alif Ba'a e-book for teaching the Arabic writing alphabet to elementary-level university students. The review will not address other factors, including Cost, Perceived Risk, Technical Service Quality, Library Service Quality, and Demographic Variables. However, these factors may be significant in broader contexts but are less critical within the scope of this study, as argued as follows.

First, cost is not a barrier to adoption because the Alif Ba'a e-book is likely to be either free or paid for by the university. In institutional settings, where students have equal access to educational resources, variations in cost have a limited impact on the acceptance of specific tools. Similarly, perceived risk has been omitted since the e-book's content, focused on

teaching the Arabic alphabet, does not represent a privacy or security concern. Additionally, the university/instructor endorsement of the Alif Ba'a e-book eases students' perceived risks.

Technical service quality has also been ruled out as a factor. The university's existing infrastructure, including robust internet access and IT support, ensures that the Alif Ba'a e-book functions as intended. The review concentrates on user acceptance rather than the maintenance or backend technical aspects, which are more operational. Library service quality is similarly deemed irrelevant in this context because the Alif Ba'a e-book is distributed directly by instructors or accessed independently online.

Finally, demographic variables such as age, gender, and income have been excluded since the target group—elementary-level university students—is relatively homogeneous regarding educational level and context. The study focuses on universal external factors such as compatibility, accessibility, and cultural preferences, which are more directly relevant to the research objectives. Excluding these factors allows for a more focused and appropriate analysis of the potential acceptance of the Alif Ba'a e-book in this specific educational setting.

2.6.1.1 Compatibility

Compatibility is a construct of the Innovation Diffusion Theory, introduced by Rogers (2003). It refers to “the degree to which an innovation is perceived as consistent with the existing values, past experiences, and needs of potential adopters” (Rogers, 2003, p.990). Both Jin (2014) and Lai and Ulhas (2012) examined the impact of the compatibility of e-books on users' willingness to accept them. Students and teachers use e-books in formats such as Portable Document Format (PDF) and Electronic Publication (EPUB) to ensure compatibility across platforms and devices. This compatibility significantly affects PU and intention to use (Chau & Hu, 2001) and leads to “preferable adoption” (Cheng, 2015; Rogers, 2003; Wu & Wang, 2005, p.721).

In his empirical study, Jin (2014) developed a hybrid model combining Theory of Reasoned Action (TRA), the TPB, Diffusion of Innovations Theory (DIT), and the TAM to distinguish external factors, such as compatibility, relative advantage, self-efficacy, and SN, from

internal factors, including PEOU, PU, satisfaction, and intention to continue using e-books. Surveying undergraduate economics and business students in two Korean universities (571 male and 459 female), Jin (2014) found high satisfaction with the PEOU and PU of e-books. However, compatibility had less impact on PU than PEOU. He recommended enhancing perceptions of compatibility, as it determines acceptance in terms of PEOU and PU (p.6). The second study (Lai & Ulhas, 2012) also combined DIT with the TAM and found that compatibility, PEOU, and PU were significant predictors of e-book adoption.

2.6.1.2 Convenience and Accessibility

Perceived convenience refers to the ease of access in terms of time, location, and task execution within e-learning (Yoon & Kim, 2007). Research shows that convenience, alongside cost and prior experience, significantly shapes students' and faculty attitudes towards adopting e-books (Chen et al., 2019). Acceptance is higher when e-books are seen as accessible and user-friendly. Gueval et al. (2015) identified key features enhancing convenience and usability, including portability, access to resources, highlighting, search functions, and citation tools. Furthermore, Alhammad and Ku (2016) note that, unlike print, e-books can be disseminated online, allowing knowledge construction anytime and anywhere. Alhammad (2017) further found that features such as keyword searches, embedded definitions, and note-saving substantially enhance learning while saving time and cognitive effort.

Accessibility factors across technological, cultural, and individual domains strongly influence the adoption of e-books for Arabic learning. Digital talking books in DAISY format enhance accessibility for print-disabled learners by integrating synchronised text, audio, and navigation (Doush et al., 2014). The Mada Innovation Ecosystem has advanced solutions such as text-to-speech and screen readers for Arabic (Al-Thani et al., 2019). Standards like IMS AccessForALL and WAI guidelines also improve e-learning accessibility (Boudhief et al., 2014). Web design for Arabic content must consider learners with difficulties through appropriate fonts and layouts (Al-Wabil et al., 2006). For visually impaired users, usability and acceptance depend on efficiency, satisfaction, learnability, and navigation (Matraf et al., 2021). Finally, culturally responsive design is crucial, as Arabic speakers have distinct

preferences in font type, size, and colour (Benaïda, 2014).

2.6.1.3 Subjective Norm

Adoption of e-books and e-learning in higher education is strongly shaped by SN, defined as individuals' perceptions of whether significant others expect them to engage in certain behaviours (Fishbein & Ajzen, 1975). SN influences students' perceptions of e-books' ease of use and usefulness, thereby affecting BI toward technology adoption (Hussein, 2018; Salloum & Shaalan, 2018; Teo et al., 2019; Yau & Ho, 2015). Social influences are thus central to adoption processes (Tarhini et al., 2013). For example, Yau and Ho (2015) identified a positive link between SN and e-learning engagement among university students in Korea and Hong Kong, while Hussein (2018) confirmed SN's critical role in e-learning use.

Empirical studies consistently show that SN significantly affects BI, PEOU, and PU. Smeda et al. (2015) demonstrated, through structural equation modelling, that SN shape adoption intentions for e-books, influencing both PEOU and PU (pp.237–238). Similarly, Martin (2022, pp.2860–2861), Abdullah et al. (2016), and Salloum et al. (2019) confirm the predictive role of SN in technology adoption. Chu and Chen (2016) extend the TPB by framing SN as group influences, while Al-Gahtani (2016) and Salloum (2018) stress their importance in e-learning contexts. Chang et al. (2017, p.16) further note that SN positively affect PEOU and PU, highlighting the role of peers, instructors, and societal expectations in shaping students' attitudes. Finally, the TAM2 explicitly incorporates SN as predictors of intention, with norms influencing PU and aligning user behaviour with social contexts (Srinivasan, 2014).

2.6.1.4 Computer Self-efficacy

Self-efficacy, the belief in one's ability to execute tasks, is central to academic motivation and performance (Bandura, 1997). It is also defined as “the belief and perception of the university students in their abilities to use e-books” (Alshaya & Oyaid, 2017, p.43). Computer self-efficacy strongly influences both PU and PEOU of e-books (Liao et al., 2018; Smeda, 2017), shaping users' perceptions of utility and accessibility and encouraging use

anytime and anywhere (Jin, 2014). According to Smeda (2017), it also affects students' attitudes and indirectly their BI through PEOU.

E-books have been shown to enhance learners' self-efficacy by enabling engagement, feedback, and easy access. Yang (2018) found significant gains among EFL learners, while the incorporation of interactive features, such as multimedia and collaboration, increased confidence in academic competence (Llorente et al., 2016; Rahmadani et al., 2019; Yorganci, 2022). Students with higher computer self-efficacy are more likely to view e-books as user-friendly and beneficial (Salloum & Shaalan, 2018), with usability features such as larger screen sizes further supporting confidence (Liaw & Huang, 2016).

The literature suggests that e-books have the potential to significantly enhance learners' self-efficacy by leveraging technological, interactive, and social features. Educators and developers can further optimise e-books by addressing usability issues to build learners' confidence and support their academic success.

2.6.2 Internal Factors

Internal factors are equally influential in shaping attitudes toward e-books, as shown in Table 8. PEOU and PU, core components of Davis's TAM (1989), have been consistently shown to impact user behaviour. Studies by Salloum and Shaalan (2018), Nazari and Abdekhoda (2021), and Mizher and Alwreikat (2023) reveal that user-friendly systems enhance PU, thereby increasing adoption. User satisfaction is another critical factor, influenced by intuitive navigation, clear interfaces, and interactive features like multimedia explanations and personalised feedback (Alhammad & Ku, 2016; Kamarulzaman & Shaari, 2015; Tri-Agif et al., 2016)

Internal Factors	Description	References
Perceived Ease of Use (PEOU)	How simple and user-friendly the e-learning system appears to be.	Davis (1989), Lai & Ulhas (2012), Mizher & Alwreikat (2023), Nazari & Abdekhoda (2021), Salloum & Shaalan (2019).
Perceived Usefulness (PU)	The extent to which using e-learning enhances	Alhammad & Ku (2016), Davis (1989), Letchumanan & Tarmizi (2013).

Internal Factors	Description	References
	performance or learning outcomes.	
Resistance to Change	Reluctance to adopt new technologies due to familiarity with existing methods.	Smeda (2017).
Language Proficiency	Impact of linguistic abilities on the adoption and use of e-learning.	Al-Wabil et al. (2006), Smeda (2017).
User Satisfaction	Degree of satisfaction with the e-learning experience.	Jin (2014), Tri-Agif et al. (2016).
Perceived Enjoyment	Pleasure derived from using e-learning systems.	Lai & Ulhas (2012), Mizher & Alwreikat (2023).
Anxiety	Fear or apprehension related to using e-learning technologies.	Ngafeeson (2011).

Table 8: Internal Variables Influencing E-learning and E-book Adoption

2.6.2.1 Intention to Use

In studies on intention to use e-books in educational settings, various factors influence the adoption and ongoing use of digital texts by students and educators. Research shows that user satisfaction, PEOU, PU, and confirmation of expectations are key determinants of the continued intention to use e-books among higher education students (Baker-Eveleth & Stone, 2015; Tri-Agif et al., 2016).

The TAM has been widely utilised to gain insights into e-book adoption. Within this framework, PEOU and PU play crucial roles in shaping attitudes and intentions towards using e-books to influence BI (Mizher & Alwreikat, 2023). Hsiao and Tang (2014) compared various technology acceptance models—including the TPB, the TAM, and the UTAUT—to explain undergraduates' BI toward adopting e-textbooks. While traditional models, such as the TPB and the TAM, effectively address critical factors like PEOU and PU, the UTAUT model offers the most balanced approach for predicting e-book adoption (Hsiao & Tang, 2014). Additionally, convenience, compatibility, trialability, observability, and awareness significantly impact students' intentions to use e-books (Qazi et al., 2018). It is also evident that students' intentions to use e-books positively correlate with their actual usage, underscoring the importance of fostering positive attitudes toward digital texts.

Usability plays a critical role in digital reading, with features such as keyword search, portability, and flexible access driving e-text adoption (Luo et al., 2021, p.1). The ability of e-books to eliminate temporal and spatial constraints enhances reading frequency and enriches the digital experience (Luo et al., 2021). Using the expectation–confirmation model, Baker-Eveleth and Stone (2015) found that when students’ expectations of usability—especially in terms of efficiency and effectiveness—are met, both satisfaction and continued use increase.

2.6.2.2 Perceived Ease of Use and Usefulness

The adoption of virtual reality learning systems is significantly influenced by PEOU and PU, as articulated by Davis (1989) and further examined by Huang and Liaw (2018). The TAM, introduced by Davis (1986), highlights the predictive role of these constructs in user acceptance and sustained use of technological innovations. Numerous studies confirm the importance of PEOU and PU in e-book adoption within educational settings. Research in the United Arab Emirates identified them as critical determinants of behavioural intentions, with PEOU directly influencing PU, suggesting that user-friendly technologies are seen as more valuable (Salloum & Shaalan, 2018). Similarly, a study integrating the TAM with Expectancy Disconfirmation Theory at Tabriz University found PEOU and PU significantly impacted e-book use, explaining over 47% of adoption variance in e-book adoption behaviours (Nazari & Abdekhoda, 2021). Further, research in Malaysian universities confirmed PEOU and PU as predictors of attitudes, with ease of navigation and usability enhancing PU and intentions to adopt and engage with e-books for educational purposes (Letchumanan & Tarmizi, 2011).

E-book adoption in higher education is also shaped by design quality, usability, and tangible benefits (Alhammad & Ku, 2016; Mizher & Alwreikat, 2023). Studies highlight the importance of intuitive navigation, clear interfaces, and interactive features—such as multimedia explanations, quizzes, and personalised feedback—as crucial to enriching learning and promoting adoption (Alhammad & Ku, 2016; Kamarulzaman & Shaari, 2015). These align with constructivist principles of active, self-directed learning (Alhammad & Ku, 2016). Overall, PEOU and PU, as central components of the TAM, continue to be significant

influences on students' attitudes and intentions to adopt e-books (Lai & Ulhas, 2012; Mizher & Alwreikat, 2023).

2.6.2.3 Interactivity or Interaction

Studying multimedia elements in e-books, Ellershaw and Oudshoorn (2007) note that incorporating program visualisations—graphical representations of program flow or behaviour designed to facilitate understanding—can promote active learning and increase student involvement (Ericson et al., 2015; Sirkiä & Sorva, 2015). Zunaidah and Asih (2024) found that multimedia in structured online environments significantly improved engagement, critical thinking, participation, interaction, question-asking, attentive listening, and teamwork. Features such as interactive quizzes with instant feedback sustain student motivation and create a sense of personalisation. In e-learning, particularly in higher education, interactive quizzes with immediate feedback have enhanced motivation and engagement by reducing uncertainty and reinforcing correct answers (El-Seoud et al., 2016; Ross et al., 2018). Qun (2025) emphasises that online quizzes provide immediate feedback that sustains interest, motivation, and enhances learning effectiveness.

Interactive feedback mechanisms also increase engagement and persistence in online courses by strengthening cognitive, social, and teaching presence (Rutz & Ehrlich, 2016). Evidence supporting active, student-centred learning highlights the importance of integrating visual, auditory, and kinaesthetic components with personalised feedback. This reflective approach can facilitate more meaningful knowledge construction, self-regulation, and enhance both immediate learning outcomes and long-term retention.

2.6.2.4 Enjoyment and User Satisfaction

Perceived enjoyment, as articulated by Venkatesh (2000), is conceptualised as the level of pleasure derived from engaging with a specific system, independent of any associated performance outcomes (p.351). Perceived enjoyment is frequently recognised as a key determinant of technology acceptance in higher education contexts, particularly concerning e-book usage (Elyazgi et al., 2015; Hsiao et al., 2015; Potnis et al., 2018). This enjoyment, in turn, encourages students to engage in e-book-related tasks because they find the process

inherently gratifying (Potnis et al., 2018). This perceived enjoyment underscores the importance of integrating enjoyable elements of educational technologies to enhance student engagement and learning outcomes. Wang and Huang (2015) noted that enjoyment is often linked to completing tasks. As experience levels rise, errors decrease, leading to higher satisfaction. Factors contributing to enjoyment include “diverse content, interaction, bright colours, and an easy-to-operate interface not only delight users but also heighten users’ enjoyment and experience” (Wang & Huang, 2015, p.19).

User satisfaction, termed “forgotten ware”, is vital for evaluating information system success (Mahmood et al., 2000, p.2). Central to e-book adoption, platform design and usability shape acceptance and sustained use, consistently influencing perceptions of utility, navigability, and effectiveness to promote wider adoption (Salloum & Shaalan, 2018). Satisfaction reflects a dynamic interaction between design, usability, and expectations, which determines its integration into academic activities. Usability drives initial adoption and long-term engagement through intuitive navigation, robust search functions, and cross-device compatibility. Streamlined interfaces enhance efficiency and satisfaction (Tovstiadi et al., 2018, p.71), while interoperability and offline access support mobile usage (Ahmad et al., 2016). Interactive features like multimedia promote engagement (Yorganci, 2022), and predictable design fosters loyalty (Tovstiadi et al., 2018), with portable devices offering enhanced readability for mobile users (Park et al., 2015).

The interplay between user satisfaction and continuance intentions is a key factor in e-book usage among higher education students. Studies have shown that satisfaction strongly influences continuance intention (Baker-Eveleth & Stone, 2015; Liu et al., 2021; Tri-Agif et al., 2016). Baker-Eveleth and Stone (2015) observe that users are more likely to remain engaged when e-books are perceived as indispensable learning tools that align with their academic or professional objectives. This dynamic is further supported by Tri-Agif et al. (2016), who highlight the importance of expectation confirmation—the extent to which users’ initial expectations are met or exceeded—in sustaining a long-term commitment to e-textbooks. Such findings underscore the critical need for providers to refine their offerings to align with evolving user expectations.

2.6.2.5 Media Richness

Media Richness Theory (MRT), as stated by Daft et al. (1987), provides a framework for assessing the effectiveness of various communication media in conveying complex information. MRT posits that richer media incorporate multiple sensory cues, including audio and visual elements, immediate feedback, and diverse language, enhancing the learning experience (Daft et al., 1987). The central premise of Media Richness Theory is as follows: “the more learning that can be pumped through a medium, the richer the medium” (Lengel & Daft, 1988, p.226). E-books exemplify this by integrating an array of multimedia elements, creating a dynamic and engaging learning environment (Alhammad, 2017; Sung & Ting, 2017). These features include embedded videos and animations, hyperlinks for improved navigation, interactive quizzes with real-time feedback, and text-to-speech functionalities supporting auditory learners (McTigue & Slough, 2010; Rupley et al., 2015). Unlike traditional textbooks, e-books provide a more dynamic and personalised environment, benefiting students through visual and interactive content (Daniel & Woody, 2013; Tsang et al., 2013).

Empirical research indicates that media-rich e-books significantly enhance knowledge retention and cognitive engagement. Students who utilise multimedia features report higher motivation levels and improved comprehension of complex concepts (Karakoç, 2021; Reid, 2016; Yorganci, 2022). This aligns with Mayer’s Cognitive Theory of Multimedia Learning (2005), which argues that presenting information through multiple modalities enhances retention and recall (Mayer, 2005). However, cognitive load theory also suggests that excessive multimedia integration can lead to cognitive overload, potentially diminishing the overall effectiveness of the learning experience (Sweller, 1988).

2.7 Design Preferences for Interactive E-books

2.7.1 Multimedia Integration and Cognitive Load Management

Effective e-book design emphasises the integration of multimedia elements under cognitive principles. Çırakoğlu et al. (2022) incorporated Mayer’s (2009) multimedia principles by blending text, images, and animations, while addressing cognitive overload through the use

of audio and visual components. This focus on cognitive load highlights the importance of facilitating meaningful learning, which plays a significant role in the practical design of educational environments (Sweller et al., 2019). Bozkurt and Bozkaya (2015) highlighted the importance of incorporating diverse multimedia elements, as informed by Mayer's (2002) Multimedia Learning Theory, to align with human cognitive processing. Phadung and Dueramae (2018) further indicated that integrating interactive multimedia within e-books can alleviate cognitive load, enhance student engagement, and boost learners' motivation for reading.

2.7.2 Interactivity and Engagement

Interactivity is central to user engagement. Phadung (2015) proposed an interactive e-book design framework to enhance literacy and second-language acquisition by integrating cultural themes and interactive technology. The framework underscores multimedia design, focuses on “visual consistency (e.g., image, animation, video, and text) and sound suitability” (p.2), aims to promote engagement through “interactivities suitable for motor skills students” (p.2), adopts “principles of brain-based learning” and cultural themes to foster a “home-school connection,” helping students “reflect their own cultures and understand cultures of the second language” (p.2). Alshaya and Oyaid (2017) created a list of 28 design criteria divided into four main areas: the user interface, content, output, overall view, and interactivity.

2.7.3 Technical Standards and Accessibility

Technical adaptability is essential for ensuring accessibility across various devices. Bozkurt and Bozkaya (2015) emphasised the importance of “multiplatform support” and features like voice-over functionality for visually impaired users. Possatti et al. (2018) emphasised the importance of testing compatibility across different devices. Alshaya and Oyaid (2017) addressed 28 interface and interactivity criteria, including font customisation and search capabilities. However, they highlighted challenges in Arabic publishing and the need for better localisation tools.

2.7.4 User-Centric Design and Usability

User-centric design significantly enhances both satisfaction and effectiveness. According to Possatti et al. (2018), using white space and a clear visual hierarchy is especially important in editorial and e-book formats. These elements facilitate navigation and improve readability by organising similar categories under a cohesive style, ultimately reducing confusion for readers. In the study by Alshaya and Oyaid (2017), students expressed a strong appreciation for highlighting and note-taking tools.

2.8 Research Gaps

Despite robust research on the relationship between design, tools, and engagement, adapting English design considerations to the Arabic script is a key challenge. These gaps are identified across multiple areas, including pedagogical effectiveness, user acceptance, and design considerations specific to the Arabic script. Despite growing interest in digital language learning tools, the potential of interactive e-books in AFL instruction remains underexplored.

2.8.1 Limited Focus on Arabic as a Foreign Language

There is also a notable lack of research specifically focused on the unique challenges and opportunities associated with teaching Arabic. Due to its diglossic nature and complex writing system, Arabic presents distinct challenges that are not adequately addressed in the existing literature. Most research focuses on general language learning or languages other than Arabic, leaving a gap in our understanding of how e-books can be tailored to meet the specific needs of AFL (Chen et al., 2023). Chen et al. (2023) examined the role of e-books in EFL education, focusing on articles published in selected journals within the Web of Science from 2011 to 2020. Their analysis involved 53 carefully selected articles, concentrating on key areas such as reading comprehension, learning strategies, and student engagement. However, the existing body of research primarily emphasises general language learning contexts, highlighting the need for further investigation into practical pedagogical approaches and e-book design to enhance teaching practices in AFL contexts (Chen et al., 2023). This limited scope fails to capture the diverse needs of the broader AFL population.

2.8.2 Insufficient Exploration of Cognitive and Metacognitive Elements

Passey's Learning Environment Framework (LEF) has been utilised in various educational settings and teacher training contexts to equip language instructors with the tools necessary to design TEL activities (Passey, 2020). In these programmes, LEF was employed with other frameworks, such as Laurillard's Conversational Framework, to guide the pedagogical design process (Essam, 2019). However, the direct application of LEF within the context of interactive e-books for learners of AFL remains unexamined, mainly, and its potential to facilitate cognitive and metacognitive development through digital tools has yet to be systematically investigated. Current research offers limited insight into how learners interact cognitively and emotionally with interactive e-books. While some studies report increased motivation and enjoyment (Elyazgi et al., 2015; Yorganci, 2022), they rarely investigate the reasons behind or the mechanisms by which such outcomes occur. Integrating sensory stimuli, such as visual, auditory, and kinaesthetic elements, alongside externalisation activities, like writing and reporting, in e-books for AFL learners has not been thoroughly examined.

2.8.3 Gaps in User Acceptance and Technology Adoption Models

Most existing research has focused on the overall adoption of e-books in higher education, often overlooking the specific factors that influence the acceptance of interactive e-books by AFL teachers and students. While external factors such as compatibility and accessibility have been examined, internal factors—including perceived enjoyment, user satisfaction, and resistance to change—within the AFL context have yet to be thoroughly explored. In their systematic review of the TAM in educational settings, Granić and Marangunić (2019) analysed 71 primary studies published between 2003 and 2018. They concluded that the TAM is a significant scientific framework and a reliable model for assessing various technological implementations in educational contexts. Nonetheless, its application in AFL instruction remains notably limited, underscoring a research gap regarding the external and internal factors that impact e-book adoption in this area. Furthermore, user-centric design principles, such as those highlighted by Possatti et al. (2018), remain underexplored in the context of teaching the Arabic writing system. The integration of the feedback feature, which

is crucial for correcting errors, remains inadequately addressed in the literature.

2.8.4 Lack of Longitudinal Studies on E-book Efficacy

Most studies on e-books in language education are cross-sectional, offering only a snapshot of user perceptions and outcomes at a single point in time. A notable gap exists in longitudinal research assessing the long-term impact of e-books on language acquisition, retention, and motivation among AFL learners and teachers. Such studies could provide critical insights into the sustained effectiveness of e-books in the field of AFL instruction. Additionally, methodological limitations persist due to the lack of qualitative data to support the quantitative findings. Few studies use mixed-methods or qualitative approaches, such as interviews or focus groups (Alhammad & Ku, 2016; Alshaya & Oyaid, 2017), and data triangulation—via interviews, focus groups, and classroom observations—is often neglected in evaluating e-book use in AFL education.

2.8.5 Insufficient Attention to Accessibility and Universal Design

Accessibility is a crucial factor in the adoption of e-books, yet it remains underexplored within the context of AFL education. While some research has addressed accessibility challenges for learners with disabilities (Doush et al., 2014), there is a notable gap in studies focused on how e-books can be tailored to meet the diverse needs of AFL learners, including those with visual impairments (Doush et al., 2014) and dyslexia (Al-Wabil et al., 2006). Furthermore, universal design principles—such as text-to-speech functionality and adjustable text size—have not been adequately incorporated into e-books (Bozkurt & Bozkaya, 2015). External factors such as compatibility and accessibility significantly influence e-book adoption but have received limited attention in AFL research. For instance, compatibility issues related to devices, formats, and platforms (Chau & Hu, 2001; Cheng, 2015; Jin, 2014; Lai & Ulhas, 2012; Rogers, 1995, 2003; Wu & Wang, 2005) and accessibility challenges due to technological, cultural, and individual considerations (Al-Thani et al., 2019; Al-Wabil et al., 2006; Benaida, 2014; Boudhief et al., 2014; Doush et al., 2014) require further exploration.

2.8.6 Gaps in the Evaluation of E-book Design Criteria

Evaluating interactive e-books for language learning necessitates carefully examining general usability principles and specific pedagogical needs. While Bozkurt and Bozkaya (2015) established an overall evaluation framework, their focus was primarily on open and distance learning contexts rather than foreign language acquisition. Their criteria fail to address the unique cognitive and pedagogical challenges associated with learning non-Latin scripts, such as the Arabic alphabet. These challenges include letter complexity, diacritic integration, and distinctiveness (Wiley & Rapp, 2019). As highlighted by Wiley and Rapp (2019), learners with limited exposure to Arabic are particularly sensitive to the complexity of letters, which encompasses various visual features, including diacritics and shape variations. In contrast, expert readers emphasise letter distinctiveness—defined by the alphabet—underscoring a developmental trajectory in which perceptual learning influences how letters are processed (Wiley & Rapp, 2019).

Current applications of interactive e-books for teaching AFL demonstrate this research gap, as available tools tend to emphasise general engagement and usability features while lacking systematic evaluation against language-specific learning objectives. Furthermore, existing AFL resources remain unaligned with design frameworks, as their interactive elements do not support the cognitive processes involved in learning the Arabic script. Educational theories such as the LEF proposed by Passey (2011), which encompasses mental, metacognitive, and societal learning dimensions, are under-utilised in e-book studies. Similarly, the PPP approach is rarely integrated into e-book frameworks despite its relevance to language instruction (Widyantoro, 2019). Bozkurt and Bozkaya's (2015) IEEC for e-books are also seldom referenced in empirical research. This study addresses these theoretical gaps by combining the TAM, LEF, PPP, and IEEC into a comprehensive design and evaluation framework.

2.9 Chapter 2 Summary

This literature review examined the adoption, design, and impact of interactive e-books in AFL education. It underscored key theoretical models—particularly the TAM, the LEF, and the PPP approach—to elucidate PEOU, PU, and interactivity. While e-books demonstrate

the potential to enhance engagement and learning outcomes, significant gaps remain in AFL-specific research, particularly in cognitive and metacognitive development, script-sensitive design, and long-term effects. The review emphasises the necessity for additional empirical research to inform a tailored digital AFL pedagogy framework.

Chapter 3: Conceptual Frameworks

3.1 Chapter Overview

This chapter introduces the conceptual foundations underpinning the Alif Ba'a interactive e-book and explains how a multi-framework approach informs design and evaluation. It synthesises four strands: Passey's LEF (2011); the PPP approach (Widyantoro, 2019); Davis's TAM (1989); and Bozkurt and Bozkaya's IEEC (2015). The chapter demonstrates how these frameworks collectively produce a pedagogically sound and user-centred design for Arabic writing system acquisition, while establishing measures for acceptance and experience. It provides the theoretical rationale for the e-book's structure, articulates the criteria by which it is judged, and clarifies the links between learning processes, design decisions, and evaluation.

3.2 Passey's Learning Elements Framework

The digital world is rapidly expanding with new tools and technologies, leading to a shift from printed books to e-books as well as a rise in TELL. Despite this, there has been little discussion and data on the types of interactive language exercises in e-books and the use of theoretical frameworks regarding the interactivity of language exercises. To address this gap, the study behind this thesis aimed to develop an interactive e-book that helps AFL students practice the Arabic writing system at the university level.

The proposed interactive exercises are theory-driven, drawing upon Passey's (2011) LEF, with categories including megacognitive, metacognitive, cognitive, social, and societal aspects. The framework was utilised in one study to identify specific learning aspects influenced by Espresso's online digital resources, which aim to improve learning experiences, foster active engagement, and support students' academic development (Passey, 2011). This thesis emphasises exploring the various components of the cognitive element to develop interactive e-book exercises to enhance AFL students' understanding of the writing system of the Arabic alphabet.

According to Passey (2011), the first element of the LEF is the megacognitive, encompassing "elements becoming recognised as fundamental to developing 'expert learners', deep

learning, and wider learning, concerned with learning that goes beyond the ability to learn, that enables learners to transfer their learning both within and across subject or interest domains, involvement in real and authentic learning” (Passey, 2011, p.45). The second element is cognitive learning, involving internalisation, internal processing, and knowledge externalisation. Passey (2011) noted that this element “consists of aspects concerned with the impact of information or external stimuli on the internal mind, forms of sensory stimuli used to engage learners, ways in which information is handled within an existing internal information context, and ways in which a learner can demonstrate or use the acquired learning” (Passey, 2014, p.23).

Passey (2014, p.23), drawing on Child (1973), describes internalisation as “how knowledge and ideas are engaged, and how they are brought in mind” (Passey, 2014, p.23). He identified three core elements: “attention,” “acquisition,” and “sensory stimuli”. Attention refers to the level of focus, interest, and willingness to engage, while acquisition means accepting knowledge into the learner’s mind and its subsequent processing (Passey, 2014). Gardner (1991) identified nine types of sensory stimuli, as shown in Table 9, which are as follows: Visual, Auditory, Kinaesthetic, Emotional, Social, Textual, Musical, Interpersonal, and Intrapersonal (Passey, 2014).

Internalisation sensory stimuli	Term Explanation
1. Visual	Visual knowledge or concepts can be conveyed through various means such as still images, black and white or coloured visuals, moving images, video conferencing, or real-life situations.
2. Auditory	Auditory learning refers to acquiring knowledge or ideas through spoken language, either from a teacher or audio files.
3. Kinaesthetic	Kinaesthetic learning involves handling resources and developing motor skills by manipulating tools like a keyboard or mouse.
4. Emotional	Emotional learning recognises knowledge acquisition through the emotional quality of knowledge or ideas presented by relating them to previous emotional experiences.
5. Social	Social learning involves interacting with peers, teachers, or others, discussing and questioning.
6. Textual	Textual learning involves reading and recognising symbolic visual forms presented, including both mathematical and literacy symbols.
7. Musical	Musical learning involves incorporating music into the message or using it to describe a scene or environment.

Internalisation sensory stimuli	Term Explanation
8. Interpersonal	Interpersonal learning involves interaction between the learner, peers, teachers, or other adults.
9. Intrapersonal	Intrapersonal learning involves internal conversations or discussions where learners ask internal questions.

Table 9: LEF Internalisation Sensory Stimuli

As for externalisation, Passey (2014, p. 23) defined it as “ways the learner makes their learning known to others” It expresses internal cognitive processes outwardly through writing, reporting, speaking, presenting, drawing, or other activities, as shown in Table 10.

Externalisation Sensory Stimuli	Term Explanation
Writing	Learner conveys thoughts through written or symbolic means.
Reporting	The learner effectively communicates knowledge or ideas using a structured and precise report format.
Speaking	Learners can express their answers to questions in a one-on-one conversation or by responding to inquiries from a group.
Presenting	Learners can showcase their work visually through images, presentations, or musical performances.
Drawing	Learners communicate ideas through drawings, from structured designs to artistic expressions.
Completing	Completing involves filling gaps, which may require inserting words or selecting options.
Moving	Externalisation involves using motor and manipulative skills to arrange items meaningfully.

Table 10: LEF Externalisation Sensory Stimuli

The third element in Passey’s LEF is “metacognitive”, referring to the methods learners use to learn and the components within a learning environment that support the identification and application of strategies, enabling the transfer of knowledge between contexts (Passey, 2011). It focuses on developing learners’ abilities to acquire knowledge and recognise factors that facilitate effective strategy use and information transfer across different contexts (Passey, 2011). This category has two main aspects. The first is “monitoring task performance”, which includes “keeping track of one’s progress and sequence in a task”, “detecting and rectifying errors”, and “regulating the pace of work”. The second is the “selection and comprehension of appropriate strategies”, such as “directing attention towards relevant aspects of the task”, “establishing connections between existing knowledge and the

material to be learned”, and “evaluating the effectiveness and accuracy of the chosen strategy” (Passey, 2011, p.47).

The fourth element is the social aspect of learning, which addresses how learners interact in classrooms and external environments. When evaluating the effectiveness of “Espresso” digital resources using the LEF framework, this category assesses learning impacts, communication, collaboration, and teamwork (Passey, 2011). Passey’s (2006) study explores factors influencing learners’ recognition of some information as more engaging or useful than others (Passey, 2011). Central to this element is learner interaction, including ‘caring thinking’, appreciation, normative direction, demonstration, discussion, empathy, scaffolding, questioning, and ‘contextual thinking’. The broader categories of ‘caring thinking’ and ‘contextual thinking’ underscore attributes such as appreciation, normativity, and empathy, alongside sub-elements like education and citizenship, situating learning within a wider societal context and shaping learners’ perceptions of its purposes and information choices (Passey, 2011, 2014).

3.2.1 Why Passey's LEF

To date, only a limited number of theoretical frameworks have been identified in the design of interactive e-books, such as Universal Design for Learning, cognitive theory of multimedia learning (Mayer & Moreno, 1998), Analysis-Design-Development-Implementation-Evaluation, Child Computer Interaction (Russman, 1997), and backward design (Wiggins & McTighe, 2011). Nevertheless, none of these theoretical frameworks saliently addresses the issue of how language teachers and educational developers might create interactive exercises for e-books. As shown in Figure 2, Passey’s cognitive element provides a framework to consider relevant learning components to develop interactive e-book activities.

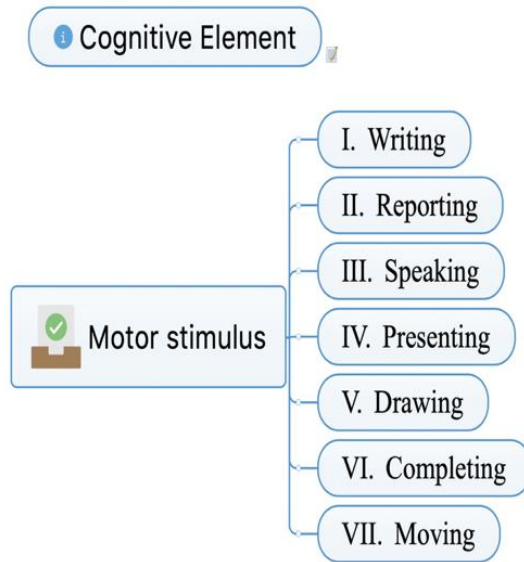


Figure 2: Passey's Cognitive Element

3.3 Technology Acceptance Model (TAM)

The TAM has been applied across disciplines such as information systems, psychology, and sociology to explain technology acceptance (Davis et al., 1989) and user behaviour in adoption (Lee et al., 2011). Derived from the TRA, TAM highlights three factors influencing acceptance: PEOU, PU, and attitude towards using technology. Davis et al. (1989) showed that perceptions of usefulness and ease of use strongly affect attitudes towards digital products, which shape adoption and usage. The TAM thus predicts BI through PU and PEOU, as shown in Figure 3.

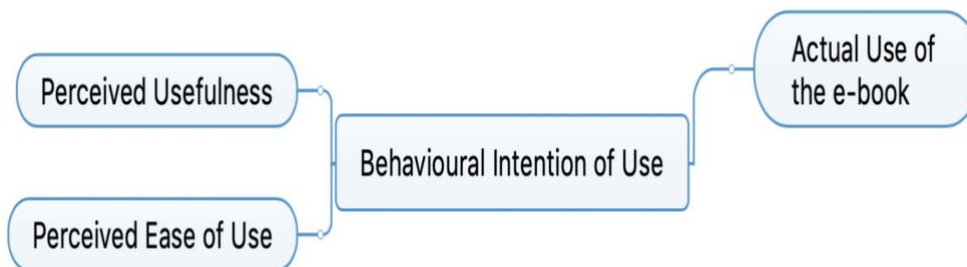


Figure 3: Technology Acceptance Model

Users' BI, influenced by attitudes and perceptions of usefulness, ultimately determine technology use (Dillon & Morris, 1996). This study examines the perceptions of AFL students and teachers regarding the Alif Ba'a e-book, with a focus on PU and PEOU as predictors of acceptance.

The TAM2 adds social influence (subjective norms, image, voluntariness) and cognitive instrumental processes (job relevance, output quality, results demonstrability, and PEOU) as acceptance predictors (Venkatesh & Davis, 2000). The TAM3 further introduces emotion and trust, acknowledging their impact on PU and BI (Venkatesh & Bala, 2008).

The UTAUT consolidates eight prior models, including the TAM and TRA, and identifies four constructs—performance expectancy, effort expectancy, social influence, and facilitating conditions—moderated by gender, age, experience, and voluntariness (Venkatesh et al., 2003). UTAUT has been applied in mobile banking (Shaikh & Karjaluoto, 2015) and payment systems (Wu et al., 2016).

TRA, introduced by Fishbein and Ajzen (1980), emphasises the influence of attitudes and SN on BI. Its extension, the TPB, adds PBC, proposing that BI depends on evaluations of behaviour, social pressures, and perceived ease or difficulty (Ajzen, 1991; Fishbein & Ajzen, 1975). Although relevant, TRA is not directly employed in this study.

3.3.1 Why the TAM

The TAM is relevant to my study due to its ability to explain factors influencing users' acceptance of technology (Davis, 1989). Its key contribution is the identification of PU and PEOU as critical determinants of users' attitudes toward adopting new technology (Davis, 1989). By measuring these factors, researchers gain insights into designing more user-friendly technologies (Davis, 1989). For example, the TAM is a robust predictor of intentions to use e-learning systems (Venkatesh et al., 2003). These findings highlight the utility of the TAM in understanding users' acceptance and adoption of technology across different domains.

Compared to models such as the TRA and TPB, TAM stands out for its focus on PU and PEOU (Venkatesh & Davis, 2000). It has undergone extensive testing and consistently

produced reliable results (Davis, 1989), enabling the design of interfaces tailored to different users, thus enhancing adoption across applications (Wang & Shih, 2009). However, it considers fewer social and cultural factors than UTAUT (Van Biljon, 2006). This focus may overlook SN and contextual influences (Van Biljon, 2006). Researchers must therefore consider study aims when selecting the TAM or alternatives.

While social elements are important, they are beyond the scope of this study, as SN is not the focus. Thus, the TAM is the most practical framework for investigating AFL teachers' and students' perceptions of the interactive e-book, specifically in terms of PU and PEOU. Consistent with Van Biljon's (2006) suggestion, this study does not prioritise social and cultural factors. The TAM excludes SN as a determinant of BI, proposed in the TRA and TPB (Ajzen, 1991; Fishbein & Ajzen, 1975). Nonetheless, it effectively predicts technology acceptance and helps identify modifications to improve user-friendliness (Lee, 2003 is therefore regarded as one of the most influential and widely used models. Additionally, the TAM, incorporating PU and PEOU, which replaced the behavioural measures in TRA (Pierce et al., 2013), will be employed here to explore perceptions of the interactive e-book.

3.4 Presentation-Practice-Production Approach

The PPP is a well-established approach in language education for introducing new language concepts to students (Widyantoro, 2019). It is widely recognised in English language teaching for developing learners' communicative skills (Harmer, 2007; Richards, 2006; Skehan, 1998) and fostering confidence in using the language (Widyantoro, 2019). Furthermore, it is highly effective for teaching grammar and vocabulary (Harmer, 2007; Shintani & Ellis, 2014).

In the presentation stage, teachers demonstrate the target concept, so students grasp it and its context. The practice stage provides student-controlled exercises—often fill-in-the-blank or matching tasks—to reinforce understanding and application (Widyantoro, 2019). In production, students use the concept in open-ended tasks to demonstrate mastery, meaningfully and creatively (Widyantoro, 2019). PPP offers a structured framework to introduce items, enable controlled practice, and encourage autonomous use in open-ended activities (Shintani & Ellis, 2014).

3.4.1 Why the PPP Approach

Building upon the PPP approach, the Alif Ba’a e-book comprises three pedagogically structured sections designed to facilitate the acquisition of Arabic alphabet letters (Tomlinson, 2012). In the presentation section, video animations and audio introduce the alphabet: animations model writing direction, audio reinforces names and pronunciation, and tongue-and-mouth visuals guide articulation. The practice section consolidates input through interactive activities—memory games and movement-based tasks that focus on matching and sequencing. The production section promotes independent letter writing, supported by listening exercises that help distinguish and identify sounds. Embedding interactivity throughout, the e-book offers an engaging experience aligned with the PPP sequence—presentation, practice, and production—enabling students to systematically acquire and consolidate their understanding of the Arabic alphabet.

3.5 The Interactive E-book Evaluation Criteria

According to Bozkurt and Bozkaya (2015), IEEC includes four themes, 15 dimensions, and 37 criteria based on expert input and heuristic analysis. As shown in Table 11 these are grouped under content, interface, interactivity, and technology—each addressing essential aspects of e-book design and effectiveness.

Main Category	Sub-category	Criteria
CONTENT	Presentation	<ul style="list-style-type: none"> • Clear and fluent language usage • Effective narration features • Preparing content with a theoretical framework that supports learning objectives
	Richness	<ul style="list-style-type: none"> • Richness of multimedia components • Balance of information density
	Motivation and Attractiveness	<ul style="list-style-type: none"> • Attractiveness of the content • Content design appropriate for characteristics of the target audience
	Assessment and Evaluation	<ul style="list-style-type: none"> • Providing mechanisms to users enabling them to assess their own learning process
	Integrity, Coherence and Connectivity	<ul style="list-style-type: none"> • Content-media coherence • Integrity of hierarchical structure of the content • Coherence of the content with learning objectives

Main Category	Sub-category	Criteria
		<ul style="list-style-type: none"> • Coherence of language and content • Coherence of learning activities with learning objectives • Connectivity of content in itself
INTERFACE	Ease of Interface Use	<ul style="list-style-type: none"> • User friendly interface • Navigation tools to avoid disorientation and provide quick access to relevant pages • Bookmarking ability • Search ability
	Customization and Autonomy	<ul style="list-style-type: none"> • Authoring support (e.g. highlighting, note taking, marking etc.)
	Interface Design, Esthetic and Consistency	<ul style="list-style-type: none"> • Simple and straightforward layout design • Legibility without fatiguing eyes • Balanced design of interface density • Consistency of buttons, icons and menu items • Consistency of interface areas • Consistency of labels and messages • Providing color balance for layout
	Universal Design for Accessibility	<ul style="list-style-type: none"> • Designing under the frame of universal design principles to ease accessibility for individuals with special needs (e.g. voice over, scaling visuals or text etc.)
	Support Services	<ul style="list-style-type: none"> • Update support for interactive e-book and content
	Layout Frame Design	<ul style="list-style-type: none"> • Applying physical techniques in layout frame design (e.g. balance, symmetry, regularity, alignment, proportion and horizontality)
INTERACTIVITY	Interaction Richness	<ul style="list-style-type: none"> • Designing interactive e-book with components/elements that can provide higher interaction level
	Digital book, environment and content interaction	<ul style="list-style-type: none"> • Providing interaction through hardware and sensors of the interactive e-book reader device* • Data feed through the Internet* • Supporting interaction and communication through social network connections*
TECHNOLOGY	Technical features	<ul style="list-style-type: none"> • Online /offline functionality • Multiplatform support • High resolution and quality of components used in interactive e-book
	Copyright	<ul style="list-style-type: none"> • Protecting interactive e-book through DRM*

Table 11: Evaluation Criteria for Interactive E-books (Bozkurt and Bozkaya, 2015, p.72 and 73).

E-book content criterion: This theme concerns the substance and presentation of the e-book. Subthemes include presentation, emphasising clear, fluent language and narration tailored to support learning objectives; richness, referring to multimedia components that enrich content while balancing information density; and motivation and attractiveness, focused on engaging content tailored to target learners. Assessment and evaluation provide tools for learners to monitor progress, while integrity, coherence, and connectivity ensure alignment with learning objectives, a structured hierarchy, and internal interconnectedness.

The E-book interface criterion addresses the user's direct and friendly interaction with the e-book, encompassing the following six elements. Ease of interface use prioritises intuitive navigation to prevent disorientation and enable quick access, with bookmarking and searchability enhancing usability. Customisation and autonomy offer authoring support—highlighting, note-taking, and marking—to personalise their interaction with the e-book to suit their needs. Interface design aesthetics and consistency strive for legibility without eye fatigue, balanced density, and consistent button, icon, menu, interface area, and label design. Additionally, providing a colour balance in the layout contributes to both legibility and aesthetic appeal. Universal design for accessibility incorporates features for users with special needs—e.g., voice-over and scalable visuals/text—by applying universal design principles. Support services ensure up-to-date support for the e-book and its content, maintaining its relevance and functionality over time. Layout frame design applies physical design techniques, including balance, symmetry, regularity, alignment, proportion, and horizontality, to create a well-structured and visually appealing interface.

The interactivity criterion addresses the e-book's interactive elements. It includes two aspects. The first is **interaction richness**, involving components that provide high levels of user engagement. The second concerns **digital books, environments, and content interaction**, which create an interactive digital space and expand avenues for engagement. This element operates through the e-book reader device's hardware and sensors, fostering a more immersive experience. In addition, internet data feeds can enhance interaction by supplying real-time updates and enabling social networking, strengthening the e-book's communicative capabilities.

The last criterion is technology, which involves the technical support for the e-book's functionality. This criterion includes two elements: first, technical features such as online/offline access, multiplatform support, and high-resolution components. Second, digital rights management (DRM) addresses copyright issues, ensuring content protection within the interactive e-book.

Together, these criteria and sub-elements provide a framework for evaluating and designing the effectiveness, usability, and technological sophistication of interactive e-books, ensuring they meet educational goals and user needs. In the upcoming sections, I will explain how I integrated these criteria into the Alif Ba'a e-book and elaborate on the intervention description.

3.6 The Intervention

The e-book consists of eight units. The first unit introduces the Arabic alphabet and the diglossic nature of Arabic. Units 2 through 8 focus on groups of letters, presenting four to six letters in each unit that share similar sounds or writing styles, along with short and long vowels. According to Elgibali (2005), "Egyptian children acquire their vowels in the following order: /a/, /e/, /o/, /i/, /u/, length, and emphasis" (p. 26). A Graphics Interchange Format (GIF) model accompanies each letter's isolated handwriting, along with a table of positional variants—initial, medial, and final. An animated video models pronunciation with adjustable playback speed. Additional slow-motion GIFs illustrate each form, followed by an interactive tracing exercise with real-time feedback, usable with a stylus or finger. The section concludes with GIFs showing the letter in varying word positions.

3.6.1 Content

3.6.1.1 Presentation

The Alif Ba'a e-book presentation uses two key features to enhance content delivery: clear language; and engaging narration. It employs simple English to ensure accessibility for elementary learners, with instructions written in clear, plain language. The Kotobee platform also supports 21 interface languages, as shown in Figure 4.

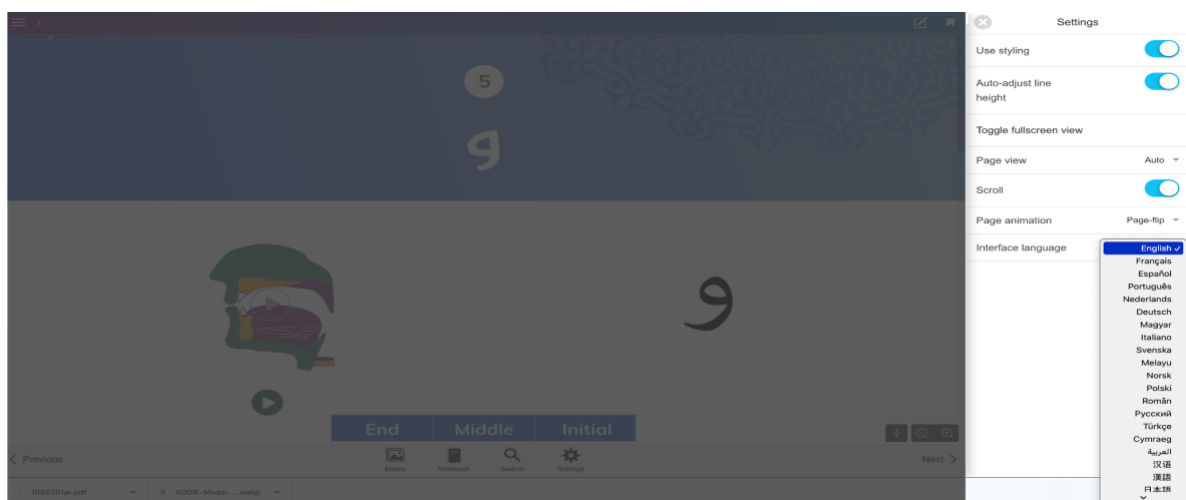


Figure 4: Language Choice in Alif Ba'a E-book

Additionally, storytelling and voice-overs are used to boost engagement but are simplified to match learners' competency levels.

3.6.1.2 Media Richness

Media richness, grounded in MRT (Daft et al., 1987), is central: "The essence of the interactive e-books lies in the interaction provided. Interactive e-books use various media to increase and support the interaction of the content using hard and soft technologies" (Bozkurt & Bozkaya, 2015, p.75). Accordingly, audio recordings model pronunciation and animated GIFs demonstrate writing for each letter in isolation and within words (see Figure 5), with three written examples per page showing letter placement in text, each paired with GIFs to guide correct writing (see Figure 6).

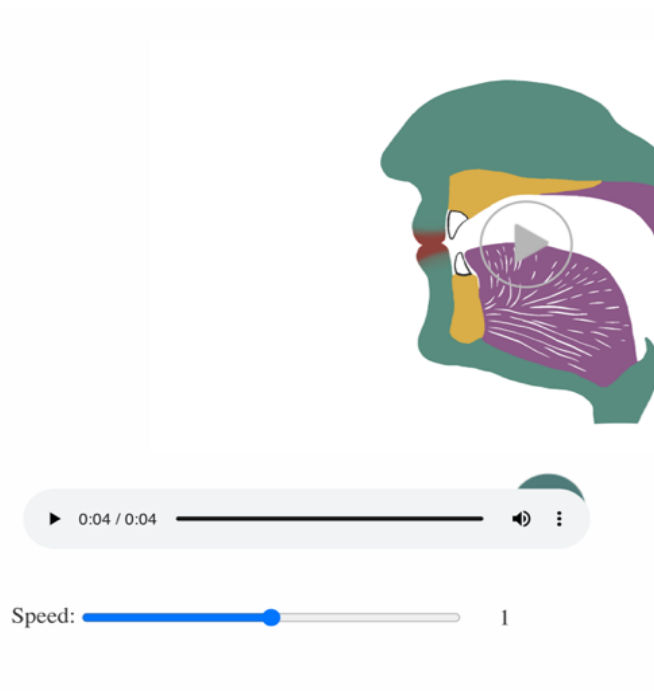


Figure 5: Pronunciation of Arabic Letters' Animation



Figure 6: Writing of Arabic Letters' GIF

This integration of multimedia and explicit modelling exemplifies effective media richness, offering interactive ways to engage with the Arabic script.

These multimedia elements, alongside games, drills, and quizzes, promote dynamic learning while maintaining an information-density balance that avoids both oversimplification and cognitive overload (Bozkurt & Bozkaya, 2015). The design targets elementary non-native learners. Letters are introduced in sets mirroring university-level Arabic textbooks, enabling gradual familiarisation, repetition, and reinforcement without overwhelming detail; reintroducing letters in varied contexts consolidates recognition (Kuwana, 2004).

3.6.1.3 Motivation and Attractiveness

When designing an e-book, it is essential to consider content attractiveness, which includes visual appeal and engagement, along with aligning the design to the target audience's interests. This involves careful choice of fonts, graphics, and navigational elements. The PPP section provides clear explanations of Arabic letters with writing, pronunciation, and word usage examples. Additionally, the practice section enhances AFL learners' skills through interactive activities like games and audio recordings for pronunciation and language skill improvement.

3.6.1.4 Assessment and Evaluation

For assessment and evaluation (Bozkurt & Bozkaya, 2015), self-assessment appears in the PPP "Production" section through quizzes and interactive exercises that give AFL learners immediate feedback on progress and alphabet comprehension, consistent with findings that electronic feedback enhances second-language learning (Koolivand & Iravani, 2013).

3.6.1.5 Integrity, Coherence, and Connectivity

The final criterion for effective e-book content presentation is integrity, coherence, and connectivity. This includes alignment between content and media, a clear hierarchy, and strong internal links. The e-book presents accurate, well-organised information, with images and videos reinforcing the text. Chapters are clearly labelled and logically sequenced, facilitating navigation. Language is tailored for clarity and learning activities like exercises

and quizzes promote engagement. Logical transitions enhance connectivity, helping learners grasp related ideas and follow the material's progression.

3.6.2 Interface

The interface criterion encompasses sub-elements such as Ease of Interface Use, Customisation and Autonomy, Interface Design, Aesthetics, Consistency, Universal Design for Accessibility, Support Services and Layout Frame Design. The subsequent sub-sections outline the application of these sub-elements in designing the Alif Ba'a e-book.

3.6.2.1 Ease of Interface Use

The Ease of Interface Use criterion emphasises the overall user experience of the e-book, focusing on ensuring its simplicity and intuitiveness for non-native speakers at the elementary level to engage with and utilise. The criterion has four sub-elements, which are considered as follows. User-friendly interface: as in Figure 7, the e-book has a clear, visually appealing, and easy-to-understand layout, ensuring that non-native speakers at the elementary level can interact with and use the e-book without confusion.

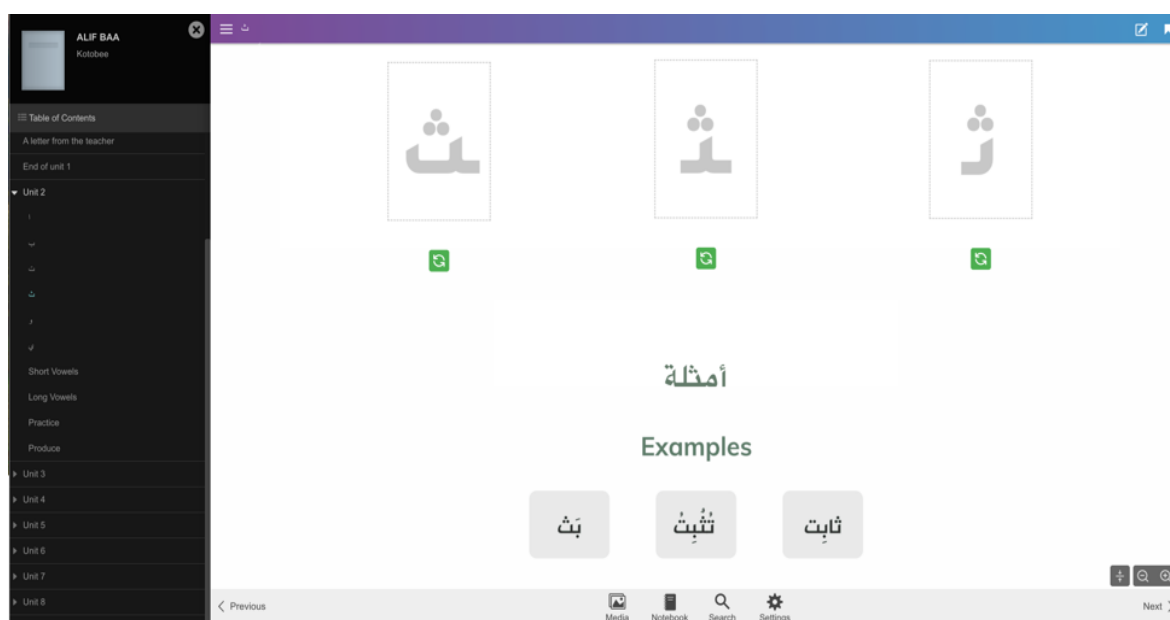


Figure 7: User-friendly Interface

Navigation Tools: it features a range of efficient navigation tools, including a table of contents, page numbers, and ‘Previous’/’Next’ buttons, as illustrated in Figure 8, which enables students to quickly locate specific sections or pages.



Figure 8: Previous/Next buttons

Bookmarking Ability: one of the standout features, as demonstrated in Figure 9, allows learners to mark specific pages or sections for future reference and efficiently revisit key content.

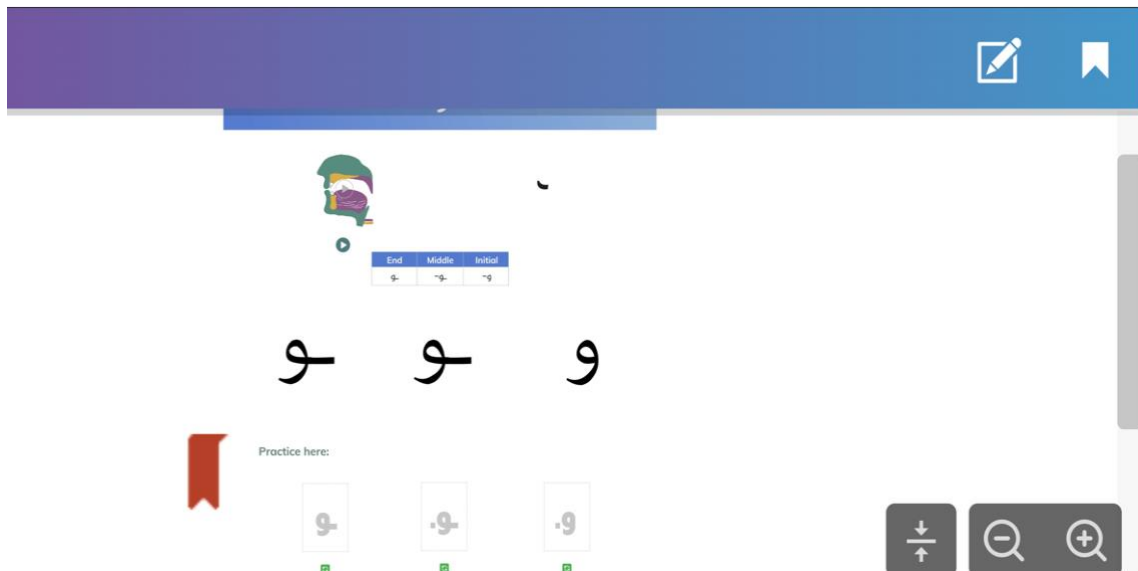


Figure 9: Bookmarking Feature

Searchability: The e-book also features a search function that enables users to locate specific words, phrases, or topics within the content, as illustrated in Figure 10, providing learners with quick access to relevant information.

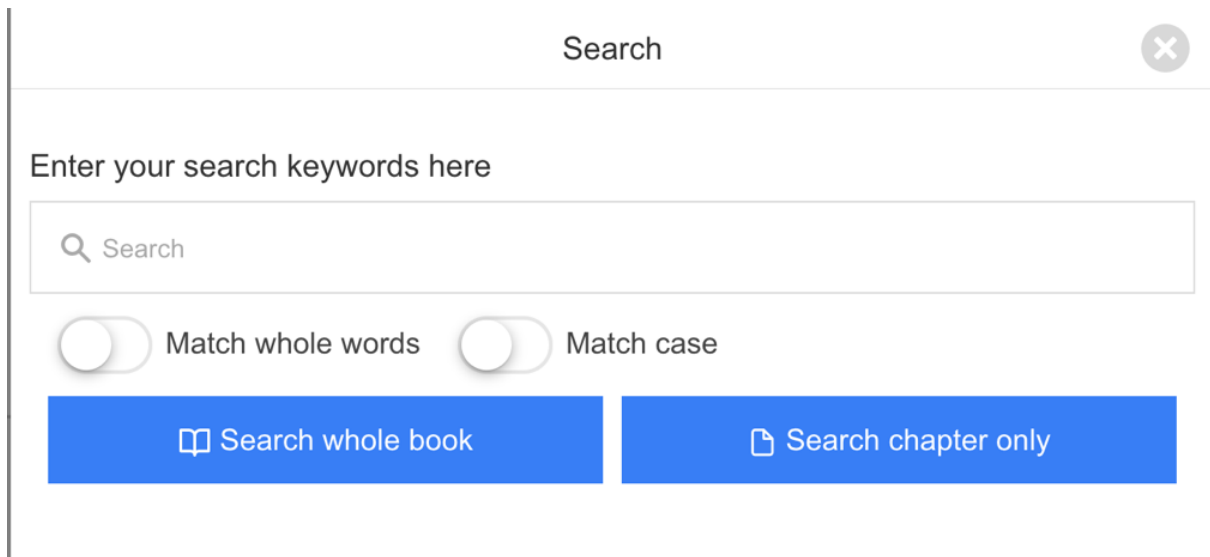


Figure 10: Feature Searchability

3.6.2.2 Customisation and Autonomy

This criterion highlights the e-book's ability to be tailored to the learner's unique needs, promoting engagement and motivation. Key authoring support tools include the Highlighting Feature: allowing learners to emphasise and revisit meaningful text, with options to export highlights to PDF, as shown in Figure 11. Note-taking, as depicted in Figure 12, allows personal notes and annotations within the e-book, aiding understanding and retention.

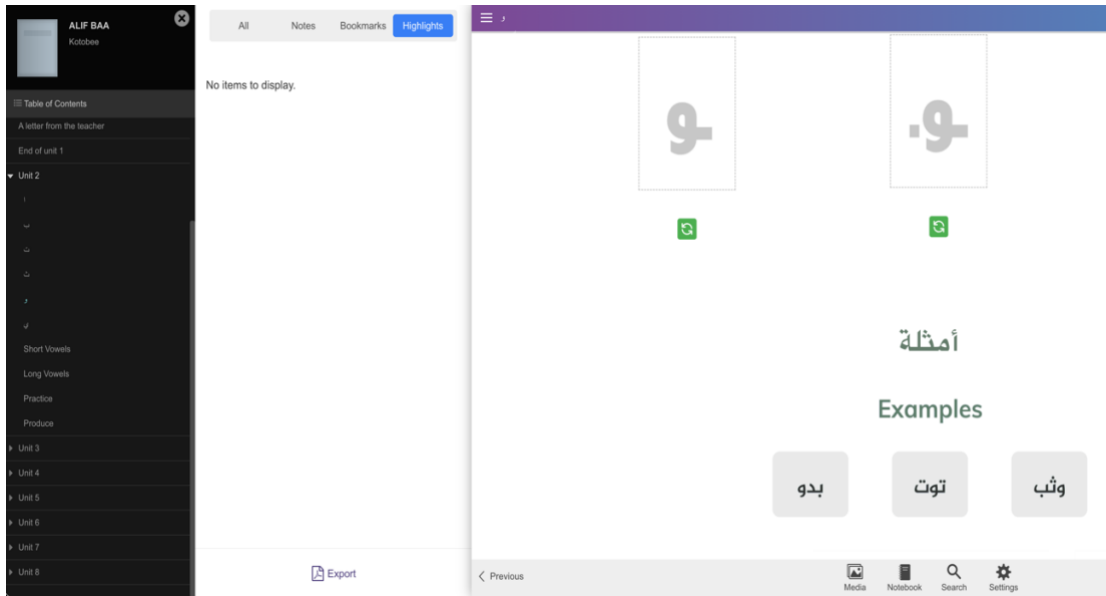


Figure 11: Highlighting Feature

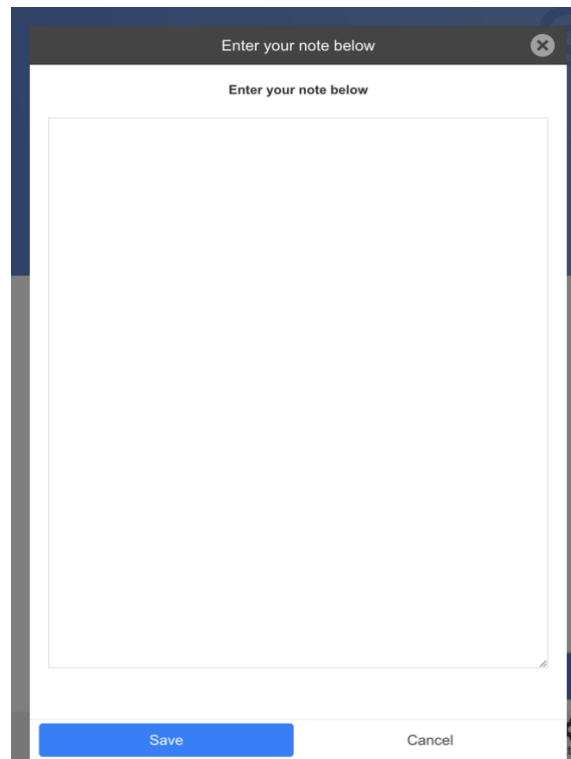


Figure 12: Note-taking Feature

3.6.2.3 Interface Design, Aesthetics, and Consistency

The third evaluation criterion for interactive e-books focuses on interface design, aesthetics, and consistency, encompassing both visual and functional aspects. It includes several sub-elements vital for a user-friendly experience: a) Simple Layout Design: the e-book “Alif Ba’a,” developed using Kotobee, features a clean, user-friendly design whose landing page showcases calligraphy of “Alif” and “Baa”, the first two letters of the Arabic alphabet. The main screen, as illustrated in Figure 13, is divided into a left ‘Table of Contents’—organised into eight units with dropdowns (e.g., “Cover”, “User manual”, “Introduction to Alif Ba’a”, “Arabic Script”, “Diglossia”, “A letter from the teacher”, and units 1–8) and a right side ‘Content Display’ presenting audio-visual materials, as shown in in Figure 13.

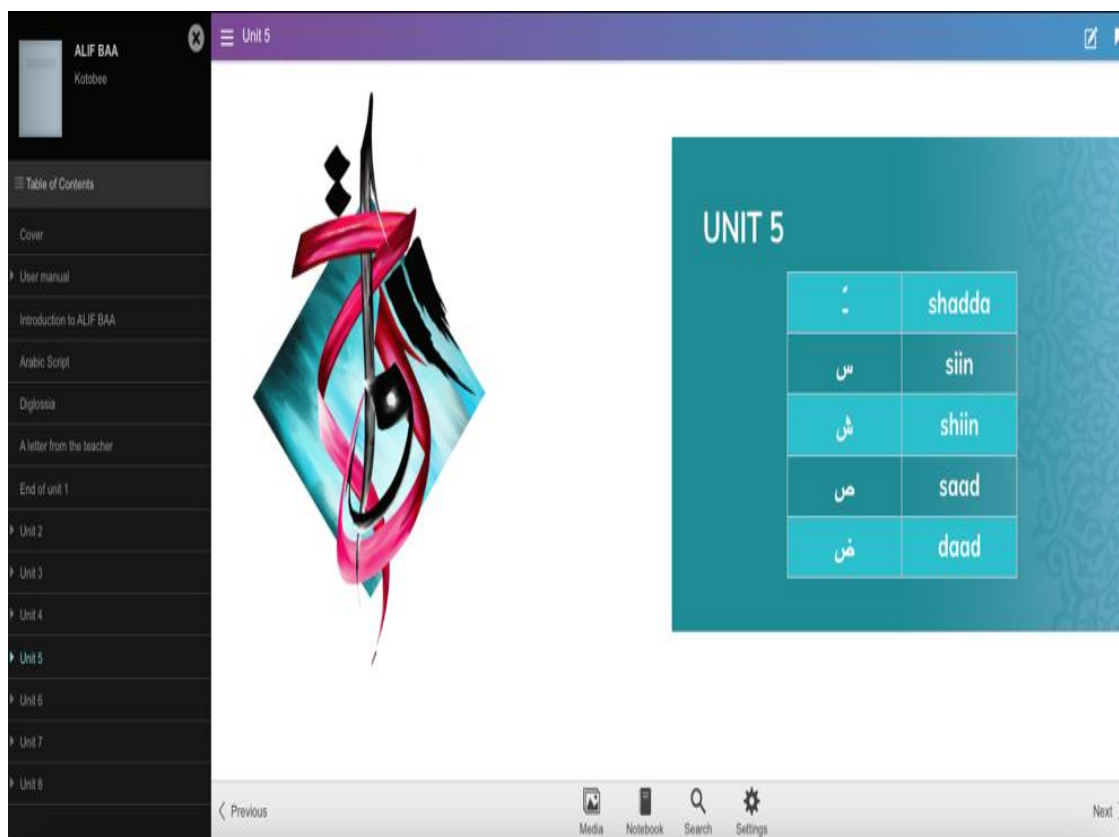


Figure 13: E-book Table of Contents

Unit 2 shows Arabic calligraphy alongside a chart listing the unit’s letters with transliterations and sections for “Short Vowels” and “Long Vowels”, as in Figure 14. Navigation elements comprise a top bar for highlighting, bookmarking, and note-taking, and a bottom bar—“Media”, “Notebook”, “Search”, “Settings”, “Next”, “Previous”—supporting seamless movement and immersion.

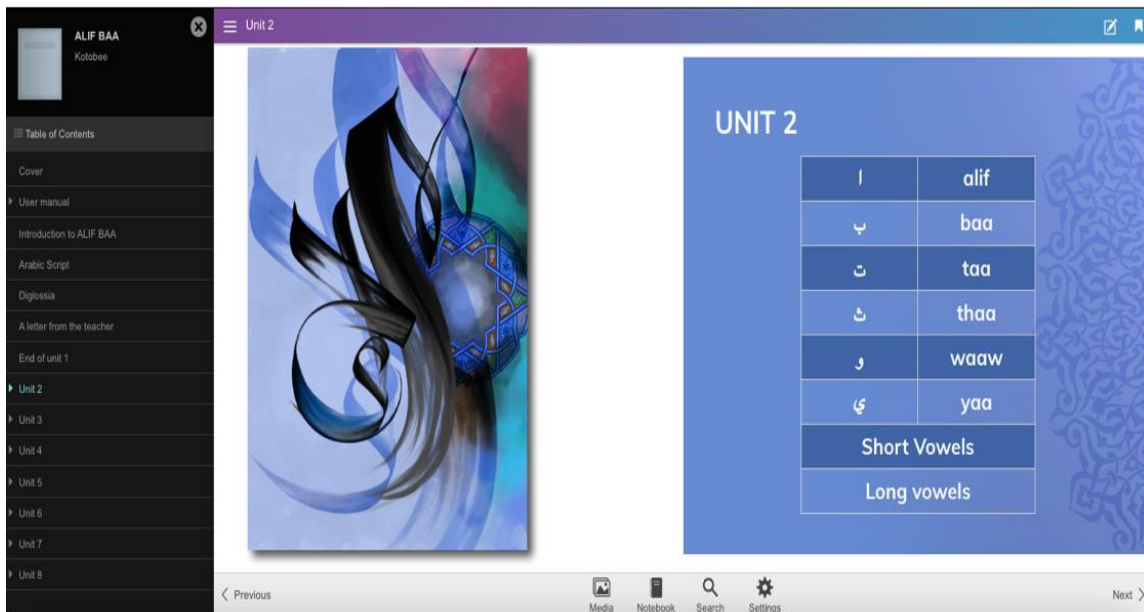


Figure 14: Unit Content Display

In addition there are features, b) Legibility Without Fatigue: where the text is designed in a clear, readable font with suitable size and contrast, reducing eye strain for prolonged reading without visual fatigue; c) Balanced Interface Density: the layout is balanced, avoiding overcrowding while maintaining legibility and clarity with well-spaced calligraphy and charts; d) Consistency of Buttons, Icons, and Menus: the buttons for “Media”, “Notebook”, “Search”, “Settings”, “Next”, and “Previous” at the bottom of the screen are uniformly designed and consistently placed, making navigation intuitive; e) Consistency of Interface Areas: uniformity is preserved in user-interface areas with controls like headings, titles, menus, and navigation bars. The top bar consistently features highlighting, bookmarking, and note-taking options for a coherent user experience; f) Consistency of Labels and Messages: the messaging tone and style are consistent across all tabs, messages, alerts, and popups,

helping to set clear user expectations and enhance the overall experience; and g) Colour Balance: an aesthetically pleasing, inclusive palette ensures harmony and avoids visual discomfort.

3.6.2.4 Universal Design for Accessibility

The Interface criterion for assessing accessibility in design pertains to creating e-books that cater to individuals with special needs by incorporating universal design principles that enhance the accessibility of the content for all users. The e-book features current support services, including help desk support, user manuals, and online tutorials, which are outlined in the e-book's user manual, as shown in Figure 15.

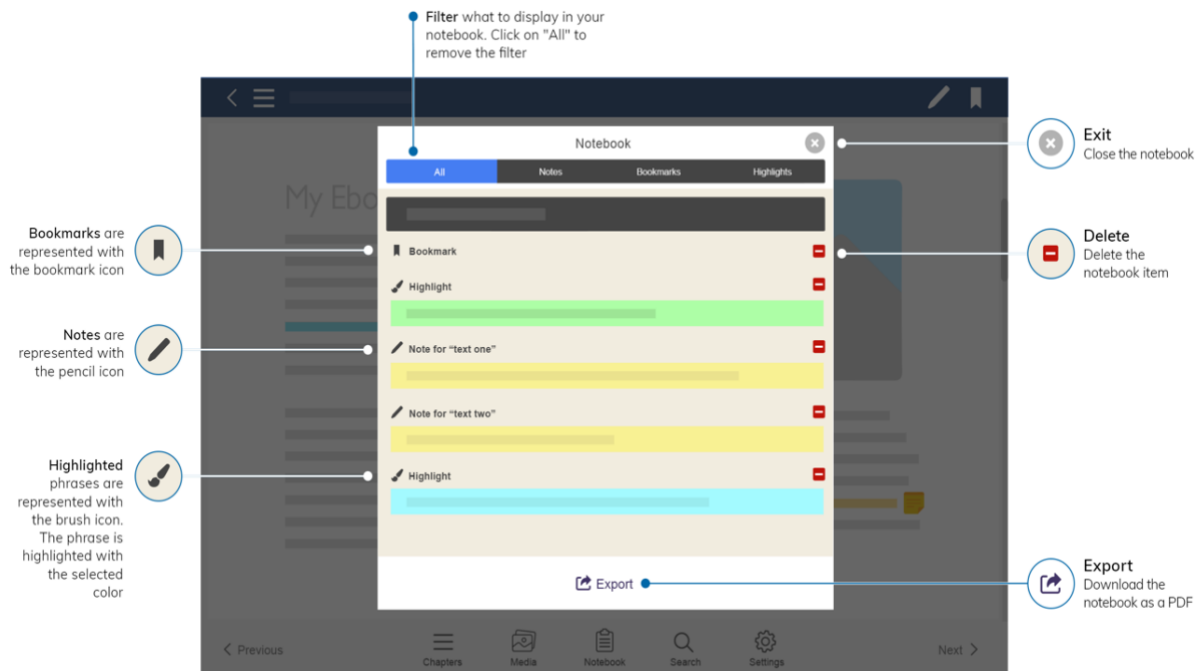


Figure 15: E-book User Manuals

Providing timely and effective support is essential for a positive interactive e-book experience and contributes to the successful integration of technology-enhanced learning experiences. The Layout Frame Design criterion in the interactive e-book evaluation framework covers physical techniques—balance, symmetry, regularity, alignment, proportion, and horizontality—to create a visually appealing layout.

3.6.3 Interactivity

The criterion of interactivity consists of two main components: interaction richness; and the interaction between the digital book, its environment, and its content, which includes (1) providing interaction through the hardware and sensors of the interactive e-book reader device, (2) data feed through the Internet, and (3) supporting interaction and communication through social network connections.

3.6.3.1 Interaction Richness

Interaction Richness refers to the degree of interactivity present in an e-book. This criterion measures how well the e-book engages readers by providing various components like images, videos, animations, quizzes, games, or simulations. In each unit of the practice section in the Alif Ba'a e-book, as shown in Figure 16, there are various formative interactive activities such as flashcards, pair matching, word search, listening and practice, connecting letters, minimal pairs, and hangman interactive activities.

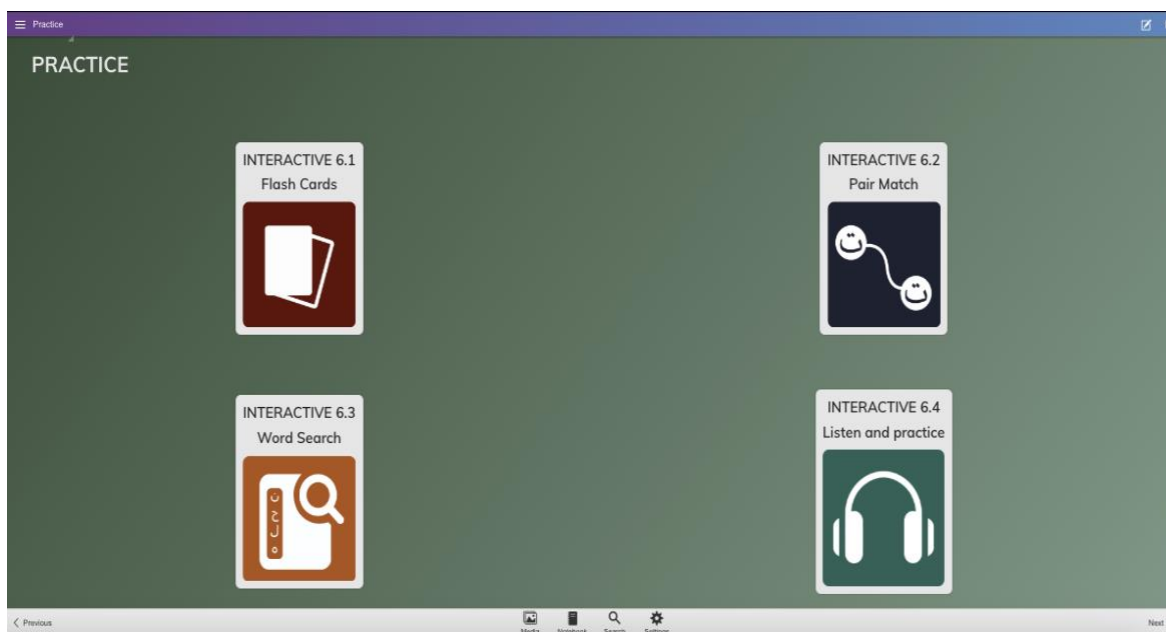


Figure 16 Practice Section

In the produce section, as shown in Figure 17, summative interactive activities include memory games, crosswords, writing activities, minimal pairs, and a quiz.

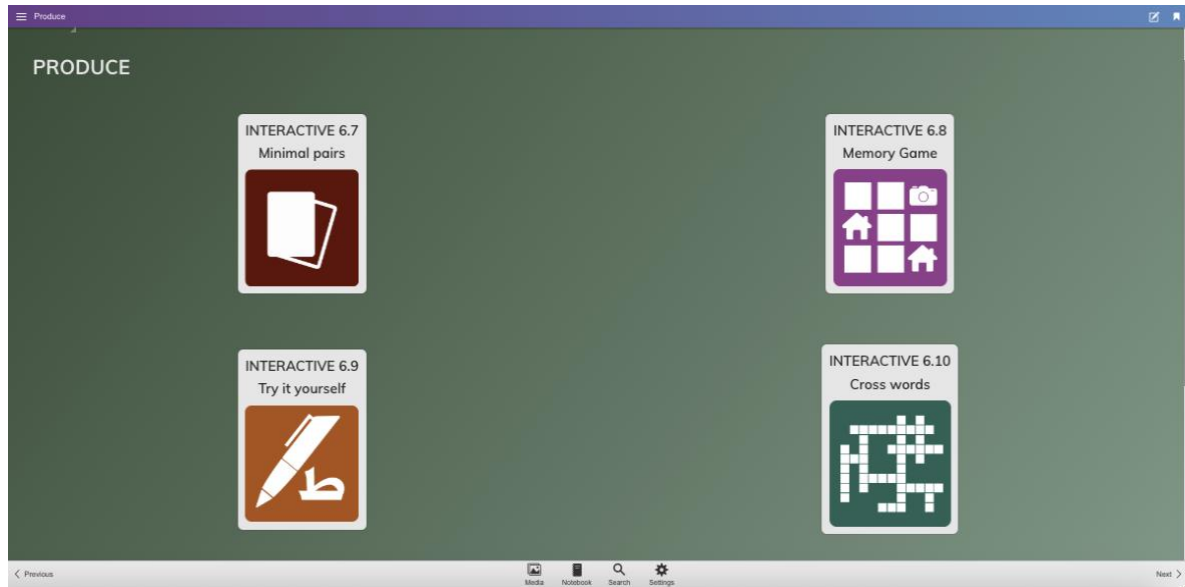


Figure 17: Produce Section

These interactive activities were developed using Book Widgets software, which allows students to share their work with their instructors for automatic grading, providing prompt feedback, and enabling teachers to evaluate and monitor students' progress. The activities developed in the Practice and Produce sections, including writing, reporting, speaking, presenting, drawing, completing, and interactive activities, are aligned with Passey's cognitive element of externalisation, enabling meaningful, practical engagement and, by integrating Passey's LEF, a more immersive learning experience.

3.6.3.2 The Digital Book, Environment, and Content Interaction

The second element of the interactivity criterion concerns interaction among the digital book, its environment, and content, leveraging e-book reader hardware and sensors, touchscreens, cameras, microphones, or motion sensors. Additionally, Internet data feeds provide access to external resources and collaboration, and communication through social network connections. To minimise distraction, the social network component is limited to e-mail, as

shown in Figure 18, and students may share work with teachers and peers via e-mail or use the download function to create a PDF.

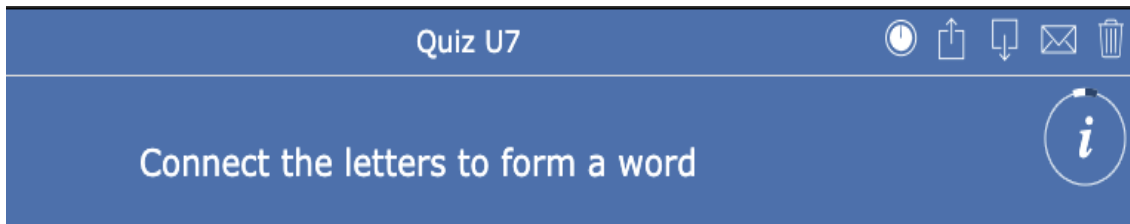


Figure 18: Sharing Feature

3.6.4 Technology

The technology criterion includes two main sub-elements. First, technical features address online and offline functionality, allowing users to access the Alif Ba'a E-book content without Internet connectivity. This e-book is compatible with the Kotobee reader software, which works on various operating systems and is available for both mobile and desktop devices. The high resolution and quality of visuals and audio enhance user engagement. Secondly, copyright protection is crucial, with Digital Rights Management measures in place to prevent unauthorised distribution and usage of the interactive e-book.

3.7 Chapter 3 Summary

In this chapter, I have delved into four essential frameworks for developing an interactive e-book on the Arabic alphabet: Passey's LEF (2011), Davis's TAM (1989), the PPP approach (Widyantoro, 2019), and Bozkurt and Bozkaya's IEEC (2015). The chapter shows how these frameworks were integrated to create a pedagogically sound and user-friendly e-book. This multi-framework approach seeks to facilitate effective Arabic alphabet learning and establish a benchmark for educational technology development.

Chapter 4: Research Methodology

4.1 Overview

This chapter outlines the research methodology, intervention, and data collection methods. It is structured into four sections. The first section reviews the DBR methodology, which was adopted due to its focus on developing and evaluating interventions in real-world contexts, and provides its rationale and limitations. DBR comprises three phases: analysis and exploration, design and construction, and evaluation and reflection (McKenney & Reeves, 2018). The analysis and exploration phase, which I referred to as the pre-design phase, involved investigating the literature for the research problem and initiating intervention development with AFL teachers. The design and construction phase followed the development and implementation of interventions, during which feedback was collected from AFL teachers and students. The final evaluation and reflection phase assessed the effectiveness of the intervention after incorporating enhancements based on the feedback received. Subsequently, the chapter details the development of interventions through DBR, describing the processes, enhancement phases, and implementation. The concluding section details the study's limitations.

4.2 Methodology Overview

The research methodology used for this study is DBR, interchangeably referred to as educational design research (McKenney & Reeves, 2012), design research (Collins et al., 2016), developmental research (Richey et al., 2004), and design experiments (Brown, 1992), as outlined by Wang and Hannafin (2005).

According to Wang and Hannafin (2005), DBR is “a systematic but flexible methodology aimed to improve educational practices through iterative analysis, design, development, and implementation, based on collaboration among researchers and practitioners in real-world settings, and leading to contextually sensitive design principles and theories” (p.7). In essence, DBR seeks “to develop research-based solutions for complex problems in educational practice” (Plomp, 2013, p.16). Therefore, by incorporating the definitions provided by Wang and Hannafin (2005) and Plomp (2013), it can be concluded that DBR is

a practical, empirical approach that enhances educational practices through a cyclical problem-solving process. Furthermore, DBR engages researchers and practitioners in real-world settings to develop solutions for complex educational issues.

4.3 DBR Characteristics

Much of the research focused on utilising DBR as a research methodology in education (Anderson & Shattuck, 2012; McKenney & Reeves, 2018; Van den Akker et al., 2006; Wang & Hannafin, 2005). These studies have presented several overlapping characteristics that define DBR. These descriptors include pragmatic research, iterative and flexible research processes, integrative research methods, and contextual research results in a real educational context. Additionally, DBR defines an educational problem (McKenney & Reeves, 2012) and focuses on designing and testing a significant intervention based on it. However, Wang and Hannafin (2005) argue that “many characteristics are not unique to DBR, but rather the nature of their use varies, and the approaches are often extended in DBR” (p.7). Therefore, I will focus on the seven characteristics of DBR proposed by Wang and Hannafin (2005) that relate to my study: 1) contextual; 2) interactive, iterative; 3) pragmatic; 4) integrative; 5) grounded; and 6) collaborative approach.

4.3.1 Contextual

DBR is a problem-solving method that provides innovative and practical solutions for real-world educational problems. It considers the context, culture, and environment in which the problem occurs (Anderson & Shattuck, 2012; Cobb et al., 2003; Juuti & Lavonen, 2006). Furthermore, DBR considers the educational context, which comprises learners, teachers, and curriculum, and emphasises the importance of ongoing feedback-based reflection on the design and implementation process to enhance the intervention (Cobb et al., 2003; Juuti & Lavonen, 2006).

4.3.2 Interactive, Iterative

DBR is an iterative process that involves multiple cycles of designing, implementing, improving, and evaluating educational interventions in a real-world educational setting while gathering and analysing data to understand how the intervention impacts teaching and

learning (Reeves, Herrington, & Oliver, 2005). Moreover, DBR involves researchers and practitioners collaborating to improve educational practice and outcomes (Barab & Squire, 2004). This process is repeated until a desired outcome is achieved (Anderson & Shattuck, 2012; Cobb et al., 2003; Juuti & Lavonen, 2006; Wang & Hannafin, 2005). This feature of DBR enables the creation of a flexible design as a solution to an educational problem in three different phases that inform each other (Franco, 2020), as shown in Figure 19.

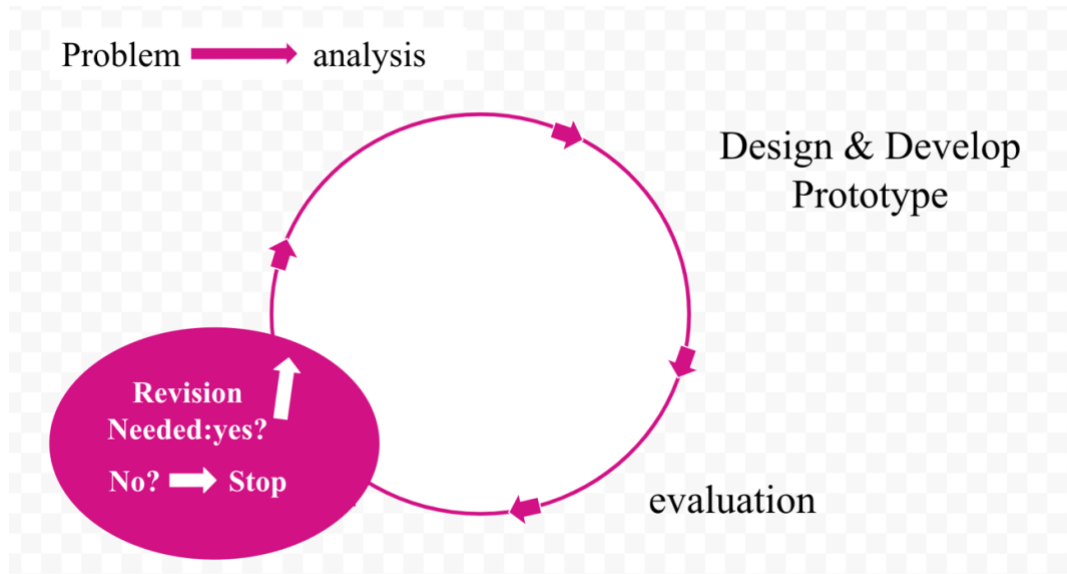


Figure 19: Iteration of Systematic Design Cycles (Plomp, 2013, p.17)

4.3.3 Pragmatic

DBR requires an ongoing evaluation and enhancement of educational interventions based on the data collected from various sources in real-world settings throughout the research process. It incorporates both empirical data and contextual knowledge to inform the design process (Anderson & Shattuck, 2012; Cobb et al., 2003; Juuti & Van den Akker et al., 2006; Lavonen, 2006; Wang & Hannafin, 2005).

4.3.4 Integrative

DBR is characterised by applying a mixed methods approach, including qualitative and quantitative research methods such as surveys, case studies, and interviews. Mixed methods allow for an understanding of the educational context and the intervention being tested, resulting in contextual research findings and generated design principles. Furthermore, as

Wang and Hannafin (2005) stated, using mixed methods increases the validity and reliability of research (p.8). Drawing from this insight, DBR combines various approaches to integrate relevant theory and practice, ensuring that the results are valid, directly applicable, and beneficial to researchers and practitioners (Anderson & Shattuck, 2012; Wang & Hannafin, 2005).

4.3.5 Grounded

Another characteristic of DBR is that it is theory-oriented or “theory-driven” (Wang & Hannafin, 2005, p.8). This methodology emphasises the integration of research and practice in developing an intervention. According to Van den Akker et al. (2006), the design of DBR is grounded in a conceptual framework and theoretical propositions, and the evaluation of intervention contributes to the development of theory. Wang and Hannafin (2005) suggest that DBR aims to refine both theory and practice and that the value of a theory is judged, based on the degree to which it informs and improves practice.

4.3.6 Collaborative

DBR is a collaborative, adaptive, and interdisciplinary approach that aims to enhance educational design through active engagement with researchers, practitioners, students, and other stakeholders. This collaboration ensures the intervention addresses diverse needs. DBR brings together experts from multiple disciplines to develop impactful educational experiences (Anderson & Shattuck, 2012; Cobb et al., 2003; Juuti & Lavonen, 2006; McKenney & Reeves, 2018; Van den Akker et al., 2006; Wang & Hannafin, 2005). Table 12 presents the DBR characteristics specific to this study, which will be discussed in detail throughout.

DBR Characteristics	Current Study
Contextual	The study centres on designing an interactive e-book that tackles the real-world problem of online Arabic alphabet instruction, considering the practical needs and challenges experienced by AFL teachers and students.
Interactive, iterative	The study adopts iterative cycles of design, implementation, and evaluation, with ongoing feedback and reflection. The first cycle draws on a literature review and qualitative input. The second cycle

DBR Characteristics	Current Study
	involves developing interactive activities, piloting a prototype, and interviewing AFL teachers and students. The third cycle quantitatively assesses their acceptance and perceptions of the refined e-book.
Pragmatic	The study addresses challenges faced by AFL teachers and students in online Arabic alphabet learning by creating an interactive e-book. It combines empirical data and contextual insights to design and evaluate the intervention, ensuring continuous improvement based on real-world feedback.
Integrative	The study employed the sequential exploratory mixed-methods design that used a range of data collection methods, such as focus group interviews, semi-structured interviews, and online quantitative surveys.
Grounded	The study was grounded in theoretical frameworks, which included Passey's LEF (2011), Davis's TAM (1989), the PPP approach (Widyanjoro, 2018), and Bozkurt and Bozkaya's Interactive E-Book Evaluation Criteria (2015). The researcher used these frameworks to guide the strategy and ensure that the e-book design and evaluation were rigorous and effective.
Collaborative	The study involved collaboration among the researcher, developer, AFL teachers, and students to design, implement, and evaluate the interactive e-book. This approach ensured it effectively addressed the challenges faced by AFL teachers and students and met their needs.

Table 12 DBR Characteristics and the Current Study

DBR is an applied methodology developed to enhance the impact, transferability, and practical implementation of educational research. Zheng's (2015) review of 162 studies reveals a primary focus on cognitive outcomes, with fewer studies examining integrated skills such as problem-solving or inquiry, and even fewer addressing attitudes and psychomotor skills (p.408). DBR is particularly useful for early-career researchers, offering practical guidance on planning and executing design research in educational contexts (Barab & Squire, 2004; Major & Wegerif, 2019). It combines theory and practice through iterative cycles of design, implementation, and evaluation (Wang & Hannafin, 2005), enabling the development of theory in authentic settings to improve educational practices (Collins et al., 2016).

This study employed DBR due to its unique capacity to bridge theory and practice (Anderson & Shattuck, 2012; Major & Wegerif, 2019). As Bakker (2019, p.4) explains, DBR

interweaves research and design, whereby “the design is research-based, and the research is design-based”. Unlike action research or formative evaluation, which focus on solving educational problems (Abdallah & Wegerif, 2014), DBR centres on technological interventions and their development to address RQs and generate practical solutions (Wang & Hannafin, 2005).

Accordingly, this study integrated the LEF and the TAM within a DBR approach to develop, implement, and refine an e-book intervention in real AFL classrooms. The iterative process enabled participants to engage with and evaluate the design across multiple cycles (DBR Collective, 2003; Plomp & Nieveen, 2007), aligning the research process with the practical application of the intervention.

DBR departs from traditional research by emphasising internal validity and context-specific insights rather than generalisability (Anderson & Shattuck, 2012). It provides a systematic means to improve educational tools while contributing to both theory and practice (McKenney & Reeves, 2012). The findings from this DBR study are expected to inform e-book design and guide future AFL interventions.

This study employed a sequential exploratory mixed-methods design. As shown in Figure 20, qualitative data collection and analysis were followed by the development of a tool tested through quantitative methods (Creswell & Creswell, 2017, p.71). As Creswell and Creswell (2017) explain, it integrates qualitative and quantitative phases in a structured sequence to build and validate research instruments. This design is particularly useful for complex, multifaceted research problems or when the study's direction is still being determined (Creswell & Plano Clark, 2017). Teddlie and Tashakkori (2020) note that integrating qualitative and quantitative data can provide a well-rounded understanding of the findings. Furthermore, combining qualitative and quantitative research methods can give a deeper understanding of the research problem.

Sequential Exploratory Design

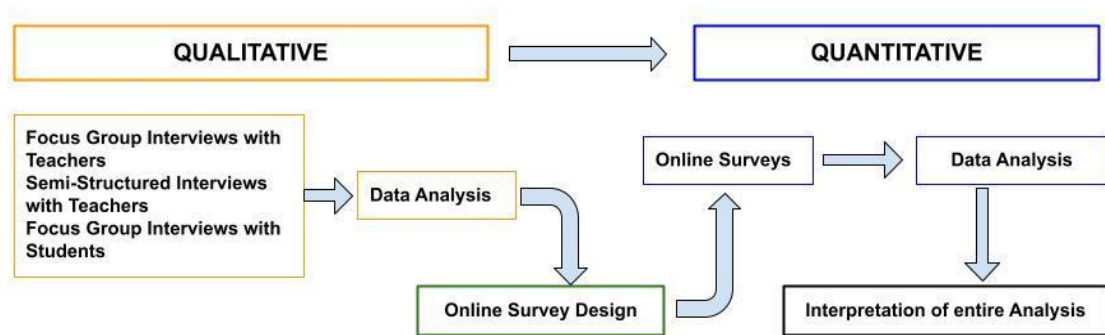


Figure 20: Sequential Exploratory Design in the Study

4.4 Phases of DBR

According to McKenney and Reeves (2018), a specific process should be followed to structure the development and evaluation of educational interventions for theoretical understanding and practice change. This process involves four main phases: “exploration/analysis, design/construction, evaluation/reflection, and implementation and spread” as shown in Figure 21 (McKenney & Reeves, 2018). First, during the exploration/analysis phase, a literature review is conducted to identify the literature gap and to address the identified problem with experts, where the researcher explores their views (McKenney & Reeves, 2018). Next, the intervention prototype is developed in the design/construction phase to solve the problem with iterative refinement involving educators’ recommendations (McKenney & Reeves, 2018). Lastly, in the evaluation/reflection phase, the researcher evaluates the intervention and gathers data for intervention users to refine the design in the next iteration (McKenney & Reeves, 2018). These first three processes are the core phases of applying DBR—the final phase is the implementation of the intervention in a real-world context.

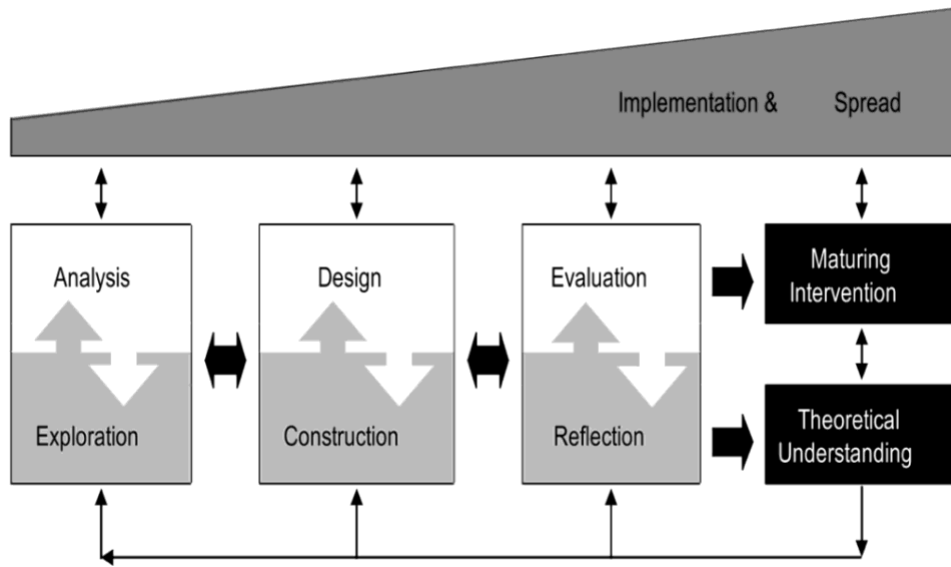


Figure 21: Generic Model for conducting Educational Design Research (McKenney & Reeves, 2018)

Implementation and spread are integral components of the DBR and are subject to mutual influence with all other elements. This indicates that the “interaction with practice is present from the start, and the scope increases over time” (McKenney & Reeves, 2012, p.77) as the project progresses, as shown in Figure 22.

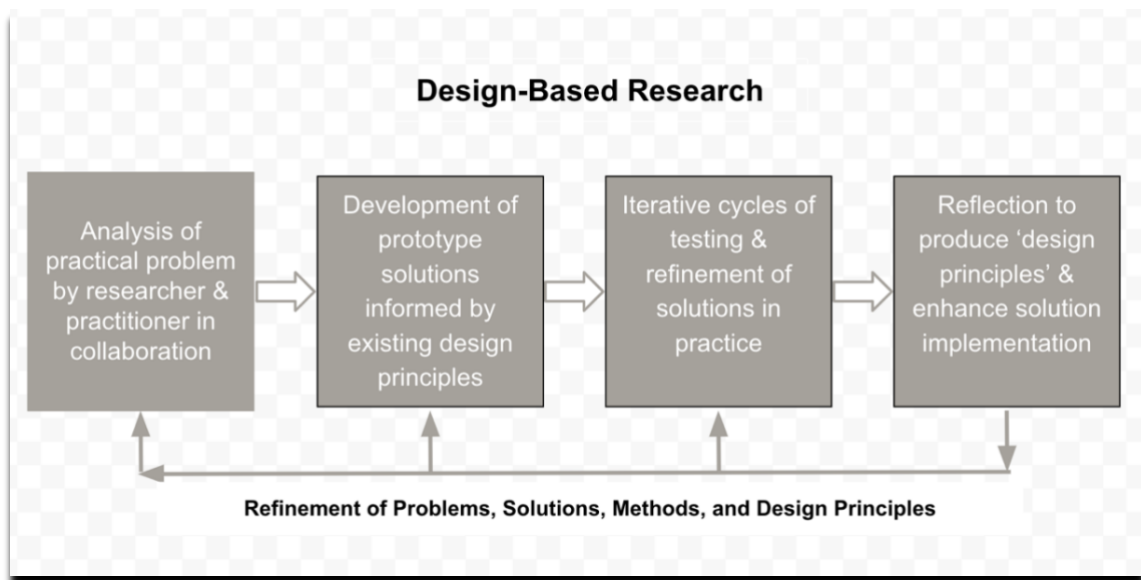


Figure 22: Phases of DBR (Reeves, 2006, p.59)

4.4.1 Analysis and Exploration

Regarding the first process, Analysis and Exploration, McKenney and Reeves (2012) highlighted the necessity of reviewing relevant “research and practitioner literature... to gain theoretical inputs that will shape an understanding of the problem, context, and other relevant topics” (McKenney & Reeves, 2012, pp.78-79). This review was essential for identifying and understanding the challenges of teaching the Arabic alphabet online after transitioning from face-to-face (F2F) methods. Learning the Arabic writing system requires observing the teacher write four different shapes for each of the 28 consonants (three representing long vowels). These are written in 17 unique forms, differentiated by dot placement above or below, while short vowels are denoted by markings serving pronunciation and grammatical functions.

I conducted a literature review to compile relevant studies addressing the problem and establish a strong theoretical foundation. This review allowed me to examine the issue from various perspectives, identify gaps in the existing literature on interactive e-books for foreign language learners and teachers, and explore the challenges and factors influencing their adoption. The transition to online instruction presented significant challenges for teaching. Consequently, exploration through collaboration with practitioners was essential to fully understand the problem and learn from their experiences in teaching the Arabic writing system online. This involved investigating potential solutions to challenges and considering their suggestions for developing the e-book intervention.

4.4.2 Design and Construction

In the design and construction phase, the researcher creates a plan for implementing and evaluating the intervention, including a detailed description, expected outcomes, and data collection and analysis methods. According to McKenney and Reeves (2012), the design and construction phase of DBR integrates insights from previous phases, literature, and practical experience; it is not purely empirical in nature, and it “resembles that of creating (not testing) a conceptual model” (p.79). In contrast to the previous phase, analysis/exploration, and the later evaluation/reflection phase, the design and construction phase follows a defined plan to develop the intervention (McKenney & Reeves, 2012, p.87 and p.79).

McKenney and Reeves (2012) have emphasised that constructing a solution involves translating design concepts into a physical product using a prototyping procedure. The anticipated solution is iteratively developed and refined in this process until the final product is achieved.

4.4.3 Evaluation and Reflection

The development of the Alif Ba'a e-book entailed substantial research and planning. Created using Book Widgets and embedded into the Kotobee platform, the eight-chapter e-book features three sections per chapter. The first introduces groups of Arabic letters through video animations that illustrate writing direction, supported by audio, written tasks, and interactive elements, such as visuals of tongue and mouth movement for pronunciation. The second section offers interactive activities and games to reinforce these letters. The final section includes exercises with instant feedback to assess writing and listening skills.

The evaluation and reflection stage determines whether the intervention effectively solves the target problem through testing and refinement (Chen & Reeves, 2020, p.3). Following McKenney and Reeves (2012), it involves analysing implementation data collected during the implementation phase to assess outcomes and identify areas for improvement. After prototyping, the Alif Ba'a e-book was evaluated through two iterative phases: real-world implementation with teachers and students, followed by feedback collection to assess the e-book's acceptance and inform enhancements to the intervention. Therefore, I collected qualitative data via individual teacher interviews and student group interviews, supplemented by quantitative data from online surveys distributed to both groups.

The Evaluation and Reflection process identified design principles applicable to similar contexts (Chen & Reeves, 2020). Reflection critically considered theoretical concepts, empirical evidence, and personal experience through both systematic and organic methods (McKenney & Reeves, 2012, p.80). In this study, a literature review, integral to the DBR analysis phase (McKenney & Reeves, 2012), examined the problem from multiple perspectives and identified gaps, particularly regarding the acceptance of interactive e-books among AFL learners and teachers. These insights informed the design of the Alif Ba'aa e-book, translating theory into a functional prototype that was iteratively developed, tested, and

refined. As McKenney and Reeves (2012) explain, empirical findings and reflective analysis serve to validate, revise, or reject the conjectures and principles embedded in design interventions (p.80).

4.4.4 Implementation and Spread

During the pre-implementation phase, collaboration was crucial to ensure that the final product met all functional, aesthetic, and budgetary requirements. E-book and application developers, graphic designers, and AFL teachers were consulted. As shown in Figure 23, the Alif Ba'a e-book design was detailed, utilising DBR. The design phase created a blueprint for the e-book based on data from the Analysis and Exploration phase, including literature and focus group interviews with AFL teachers. This blueprint served as a roadmap defining categories of letter presentations, practice exercises, evaluation activities, and constructing and implementing the intervention. Furthermore, AFL teachers using the e-book received brief instructions and training on its classroom employment, including introduction, usage instructions, plans for out-of-class activities, revising grades, and managing assigned activities.

In the Spread phase, AFL instructors implemented the e-book in five (Fall 2021) and four classrooms (Fall 2022). Feedback was collected via individual semi-structured interviews with teachers and focus group interviews with 17 students, focusing on intervention outcomes guided by the TAM (Davis, 1989), Passey's (2011) learning framework, and the IEEC (Bozkurt & Bozkaya, 2015). The collected data were analysed to assess e-book acceptance, identify implementation challenges, and gather improvement suggestions, informing refinements before re-entering the Implementation phase for the third DBR cycle. The final assessment phase involved testing the intervention, evaluating its effectiveness, and reflecting on further improvements.

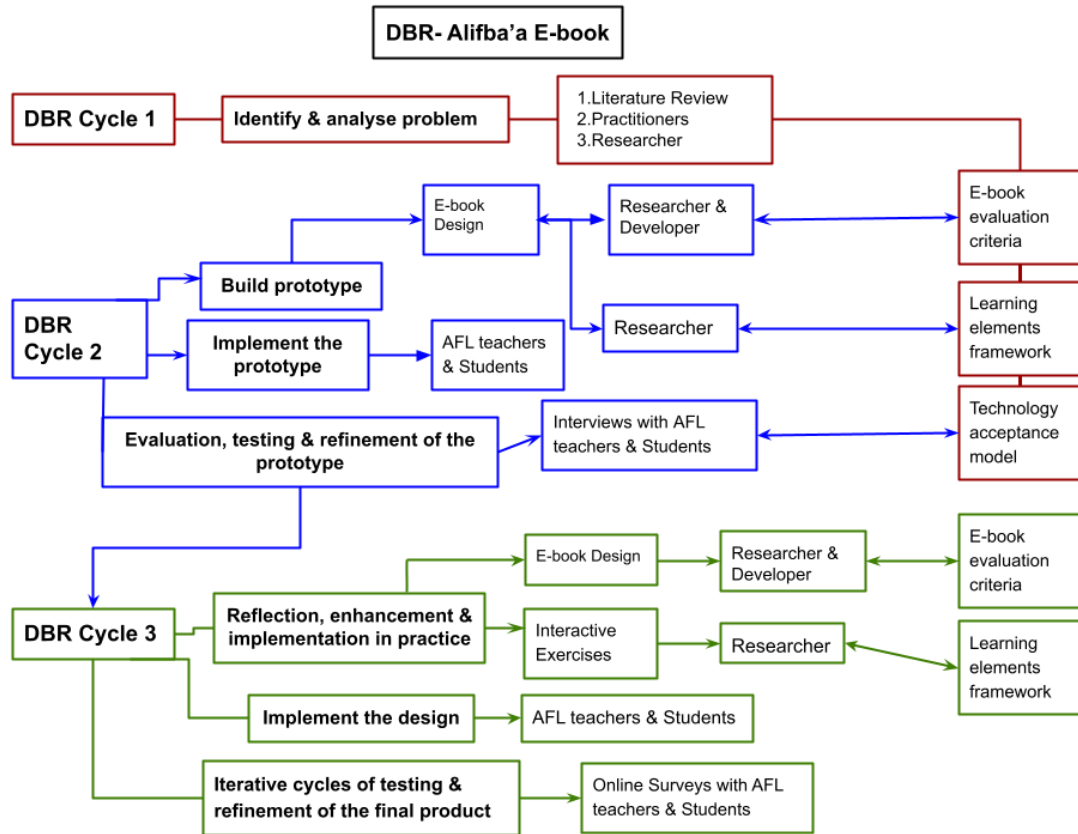


Figure 23: Alif Ba'a Design Using DBR

4.4.5 The Researcher's and Designer's Roles

Anderson and Shattuck (2012) note that collaboration between researchers and practitioners is central to DBR, though such partnerships often face obstacles. Teachers may lack research training and be burdened with instructional duties (p.17), while researchers may be unfamiliar with institutional and cultural contexts vital for effective design (pp.16–18). In DBR, the researcher-designer plays a pivotal role in both developing and evaluating interventions, often co-designing with educators and developers to ensure contextual relevance (Anderson & Shattuck, 2012). This role may also involve acting as a facilitator or technical assistant. As Knowlton (2007) asserts, this dual role deepens understanding of both research and development.

A key challenge in DBR is balancing the dual roles of designer and researcher, as one must simultaneously shape and observe the learning environment (Barab & Kirshner, 2001; Knowlton, 2007). Van den Akker (1999) stresses the importance of aligning these roles to

maintain internal coherence across the intervention.

In this study, I utilised Book Widgets to design the e-book's layout and interactive exercises, which were divided into practice and production tasks. Practice tasks included audio-video aids for letter recognition and writing, while production tasks required composing words and sharing them with teachers. These were integrated into Kotobee Author by a developer. Data collection from teachers and students occurred over three phases, enabling iterative refinement based on empirical feedback.

4.5 Limitations of DBR

There are certain limitations to be considered while conducting this study. I will focus on the limitations deemed most challenging and relevant to the current study. These limitations comprise time constraints, limited generalisability, and ethical challenges.

4.5.1 Time-consuming

A major limitation of DBR is its time-intensive nature. Because it requires sustained engagement with participants and multiple iterative cycles of design, implementation, and evaluation, DBR often demands significant time, financial, and human resources. In this study, the research began in 2020, with the Alif Ba'a e-book prototype developed in summer 2021 and implemented that fall. Feedback was collected and analysed across winter 2021 and spring 2022, leading to revisions and reimplementation in fall 2022. Survey development and quantitative analysis were conducted in winter and spring 2023. Each cycle involved coordinating with teachers and students across time zones and maintaining communication with the developer.

Despite these challenges, effective planning enabled the study's completion within a structured timeline. While Zheng (2015) and Pool and Laubscher (2016) endorse DBR for short-term projects, they also acknowledge that its typical use in single-iteration formats can limit its full potential for long-term research impact.

4.5.2 Limited Generalisability

Generalisability in DBR can pose a challenge when applying research findings to other

contexts and populations, as DBR studies are typically conducted in specific contexts with participants, resulting in highly contextualised findings that are not easily generalisable to other settings (Hoadley & Campos, 2022; Parmaxi & Zaphiris, 2020). However, DBR is useful in fields where credible inference is complex, but it is challenging to make generalisable conclusions. As a result, researchers must be transparent regarding the limitations of their study's generalisability and carefully consider the potential transferability of their findings to contexts and audiences.

4.5.3 Ethical Challenges

One of the most challenging issues in conducting a DBR study is collecting data from multiple sites, which may require ethical approval from multiple sites. This process can be complex and time-consuming, as each International Review Board (IRB) may have different requirements and timelines. For example, in the present study, it was impossible to collect data from the American University in Beirut and the American University in Cairo. This is because these universities require obtaining IRB approval internally, even though the author had already obtained ethical approval from Lancaster University in the United Kingdom (see Appendix 1).and IRB approval from Site A in cooperation with the Qatar Health Ministry.

4.6 Chapter 4 Summary

This chapter details the study's DBR methodology and the development of the Alif Ba'a interactive e-book. It underscores DBR as a practice-centred approach that effectively bridges theory and design within authentic contexts, promoting iterative improvements. The chapter delineates the four phases of DBR—exploration/analysis, design/construction, evaluation/reflection, and implementation/spread—and elaborates on the intervention employed across cycles. The e-book was developed using Book Widgets and integrated into Kotobee. Each chapter features animated letter modeling, audio components, interactive exercises, and instant feedback, and was implemented with both educators and students. Additionally, the chapter highlights the collaborative role of the researcher-designer alongside teachers and developers

Chapter 5: Data Collection Methods

5.1 Overview

This chapter details the mixed-methods used to collect and analyse evidence in each cycle. For every iteration, I specify the research context, sampling strategies, and participants, then describe the qualitative methods (focus groups/interviews) and quantitative methods (surveys) and how their results were integrated to drive redesign. I also outline the analytic procedures—qualitative coding and thematic analysis, quantitative descriptive/inferential analyses, and triangulation—to enhance validity, reliability, and robustness. Ethical protocols were followed throughout to safeguard participants’ rights and well-being.

5.2 Positioning DBR in This Study

DBR employs a practice-centred approach where design and inquiry occur iteratively in authentic contexts, yielding insights that inform subsequent cycles. This study uses DBR to tackle the pedagogical and technological challenges of teaching the Arabic alphabet online by integrating problem analysis, intervention design, and evaluation within real AFL classrooms. It fosters collaboration with instructors, allowing design principles to evolve as evidence accumulates (McKenney & Reeves, 2018).

The study followed iterative cycles corresponding to exploration, design, and evaluation phases. Initially, challenges in online instruction were identified with AFL instructors, followed by the creation of an interactive e-book prototype. This prototype was then evaluated by teachers and students, leading to refinements based on the gathered evidence. The approach combined qualitative preliminary design with quantitative survey data for broader usability and acceptance assessment.

5.3 An Exploratory Mixed-methods Design

Data collection involves gathering and analysing data from different sources to identify patterns within a population or phenomenon (Creswell & Creswell, 2017). According to Creswell and Creswell (2017), collecting reliable, representative data to address RQs or test hypotheses ensures validity and generalisability. Data collection methods include surveys,

interviews, observations, experiments, and secondary data sources (Creswell & Creswell, 2017). Surveys and interviews collect individual data, while observations and experiments gather data in natural settings (Neuman, 2014).

The study adopts DBR, characterised by an iterative interaction between design and research, each informing the other (McKenney, 2016), investigating problems to generate design concepts tested in real-world contexts. This study alternates between meetings with AFL instructors to identify challenges in teaching the Arabic alphabet online and the development of an e-book prototype. The prototype is evaluated by AFL educators and students, leading to design refinements; this cycle is repeated to enhance the intervention's impact (McKenney & Reeves, 2018).

Beyond the general DBR challenges, this study faced additional logistical and methodological complexities. Differing academic calendars across sites hindered simultaneous data collection from students and teachers, necessitating three separate cycles. Moreover, alongside Lancaster University's ethical approval, internal IRB approval from Site A in Qatar added administrative complexity.

This study employed four data collection methods aligned with the empirical phases of DBR as outlined by McKenney and Reeves (2018). Exploration/analysis drew on literature reviews and teacher focus groups; design/construction used student focus groups and teachers' semi-structured interviews; and evaluation/reflection employed online quantitative surveys for students and teachers, enabling robust triangulation.

The mixed methods approach involved utilising one method to inform and develop the other (Schoonenboom & Johnson, 2017). As shown in Figure 24, pre-study teachers' focus group discussions identified challenges in teaching the Arabic alphabet online and generated suggestions for developing the e-book, which informed the design of the prototype. These insights then shaped individual teacher interviews and student focus groups after the second DBR cycle, and the qualitative results guided the development of the subsequent quantitative online surveys.

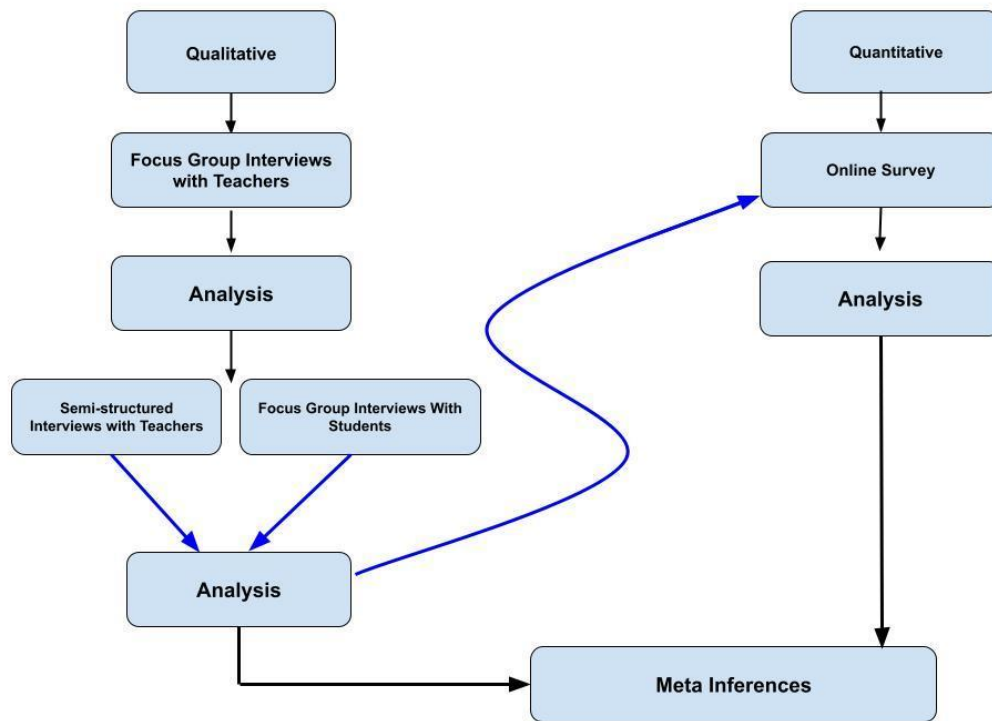


Figure 24: Illustration of the Exploratory Sequential Mixed-method Design

5.4 Focus Group Interviews with Teachers

Exploratory focus group interviews are a valuable method in DBR, offering rich qualitative data to inform design decisions (Biggs & Tang, 2011). They enable participants to share perspectives and experiences, offering insights into the issue under study (Krueger & Casey, 2015). A key advantage is their ability to explore complex and nuanced issues; in my study, they significantly influenced the design of the Arabic alphabet e-book and its interactive features. Additionally, focus groups efficiently collect data from multiple participants, which is particularly beneficial in DBR where rapid, iterative feedback is essential (Krueger, 2014). They are also cost-effective and relatively easy to organise, making them accessible to researchers with limited resources (Krueger, 2014).

Unlike individual interviews, group interviews require the researcher to facilitate dialogue, encourage participation, and manage group dynamics (Taylor et al., 2015, p.131). The funnel approach—starting with broad questions and narrowing to specifics—is common in both formats (Stewart & Shamdasani, 2014) (see Appendix 2). Furthermore, Flick (2017) noted

that focus groups are valuable in mixed methods research, offering early feedback to guide survey development or intervention design (p.252).

5.4.1 Sampling Strategies and Participants

In the first cycle of my study, I utilised Zoom software to conduct two semi-structured focus groups with eight AFL teachers that lasted approximately one hour each. The selection of participants in this qualitative data collection approach was based on snowball sampling techniques, whereby one participant recommended a new potential participant (Morse, 2007). The participants were initially prompted to discuss RQs 1 and 2 (see Appendix 3).

The initial data-collection process was initiated during the second week of November 2020, preceding the design of the e-book. The objective was to obtain perspectives and feedback from teachers who had just taught the Arabic alphabet in September and October, who would bring valuable insight into the challenges they and their students faced during the online teaching process. In addition, the aim was to leverage this information to gain insights into the requirements and suggestions for developing a helpful tool such as the Alif Ba'a e-book. The study involved the participation of AFL teachers from various educational institutions, which included Sites A, B, C, D, E and F.

5.5 The Second Cycle of DBR

The second cycle of the DBR aimed to achieve two objectives. The first was to develop a prototype for the interactive e-book and subsequently deploy it in actual classrooms among AFL teachers and students. The second objective was to explore the perceptions of both AFL teachers and students regarding e-book design, PEOU and PU. To meet these objectives, I conducted five semi-structured interviews with AFL teachers and four focus group interviews with AFL students. The results of the qualitative data were used to inform the online survey in the following cycle.

5.5.1 Semi-structured Interviews with Teachers

According to Given (2008), "Semi-structured interviews are qualitative data collection strategies in which the researcher asks informants a series of predetermined but open-ended

questions” (p.810), with follow-up questions based on participants’ answers for clarification (Given, 2008; Wilson, 2013). Rubin and Rubin (2011) identify three types of qualitative interview questions: “main questions” to guide the discussion, “probes” for clarification or to solicit examples, and “follow-up questions” to explore implications of initial responses (pp.145–146) (see Appendix 4). Valuable for collecting in-depth data on participants’ thoughts and experiences (DeJonckheere & Vaughn, 2019), this method was employed in this study with AFL teachers to explore their perceptions of an interactive e-book for teaching Arabic writing. The interviews provided rich data on their experiences, acceptance, and views of the e-book’s effectiveness and usability, as well as the challenges they encountered, allowing for flexibility and spontaneity in responses.

Five semi-structured interviews were conducted in November 2021 with AFL teachers via Zoom software, following the completion of the course. The inquiry focused on RQs 3 and 4 (see Appendix 3) and their feedback on the e-book’s positive and negative aspects.

5.5.1.1 Sampling Strategies and Participants

Guided by the principle of selecting information-rich cases for in-depth study (Patton, 2014), I utilised purposive sampling in Cycle 2 to gather detailed feedback on the e-book. The inclusion criteria were instructors who participated in the pre-design phase, were aware of the study’s aims, and had used the e-book with beginner-level students in Fall 2021. This ensured they could provide insights on both design intent and classroom use.

Five AFL instructors from Denmark, the USA and Qatar were invited via email and agreed to participate. The sample size was determined pragmatically to balance cross-site perspectives with depth, prioritising analytic sufficiency over statistical representativeness. Each semi-structured interview, lasting about 75 minutes, included a guided e-book walkthrough on Zoom, where I navigated the chapters and used open-ended prompts to gather perceptions of PU and PEOU. Sessions were audio-recorded, transcribed, and checked for accuracy, while field notes captured reflections on usability and contextual factors. This approach linked data to RQs and allowed unanticipated themes to emerge. Limitations, including potential positive bias from prior collaborators and the small expert sample, were acknowledged and addressed through triangulation with student focus groups and a

subsequent survey phase.

5.5.2 Focus Group Interviews with Students

In Phase Two of the DBR, I interviewed 17 students in four focus group sessions. The groups included 11 female students and six male students from 10 nationalities. The interviews were conducted for a duration of 50 to 60 minutes each. The purpose of using focus group interviews with the students in this study was to gain insight into the challenges they and their teachers faced concerning the PEOU and PU of the AFL interactive e-book. Through these interviews, I sought to gain a deeper understanding of technical or usability issues encountered by the students when using the e-book and their perceptions of its usefulness for their language learning (see Appendix 5). Additionally, the group interviews provided an opportunity to explore teacher challenges related to the e-book, such as difficulties adapting the materials or providing adequate support to students.

The students were asked to answer RQs 5 and 6, as well as other sub-RQs (see Appendix 3).

5.5.2.1 Sampling Strategies and Participants

After compiling the course, four focus group interviews were conducted with students who used the e-book, alongside teachers previously interviewed through semi-structured sessions. The teachers coordinated suitable times for the Zoom meetings with their students. Each session lasted between 50 and 60 minutes.

Focus Group 1: Six students — four females (India, Pakistan) and two males (Ethiopia, Uzbekistan)

Focus Group 2: Four students — two females (Philippines, Kazakhstan) and two males (USA, Pakistan)

Focus Group 3: Four students — three females (Pakistan, Uzbekistan) and one male (USA)

Focus Group 4: Three students — two females and one male (all from the USA)

All interviews were conducted in English, recorded via Zoom (screen and audio), and later

transcribed using Microsoft 360's transcription tool, with transcripts reviewed for accuracy. Participation was entirely voluntary. During the sessions, I shared my screen to display and navigate through the e-book, which helped guide the discussion and respond to emerging topics. This interactive format facilitated deeper engagement with the participants and provided valuable user insights.

5.6 The Third Cycle of DBR

5.6.1 Quantitative Data Source

This mixed-methods study used two quantitative online questionnaires to examine AFL teachers' and students' acceptance and perceptions of the refined Alif Ba'a e-book. As Nayak and Singh (2021) define it, "a questionnaire is a research instrument consisting of a set of questions (items) intended to capture responses from respondents in a standardised manner" (p.87). So, in this mixed-method study, I employed two quantitative online questionnaires. The questionnaire items were adapted from existing questions developed by Davis et al. (1989) (see Appendices 10 and 11).

Based on the needs identified during qualitative interviews, the development of the study questionnaires was informed by the results obtained from both the semi-structured interviews conducted with AFL teachers and the focus group interviews conducted with students. The aim of this survey was for the students to answer RQs 7 and 8 (see Appendix 3).

5.6.1.1 Online Survey

The TAM questionnaire was used to assess users' acceptance of the refined AFL e-book. Traditionally developed by Davis et al. (1989), the TAM employs a 7-point Likert scale ranging from "strongly agree" to "strongly disagree" and measures three core constructs: PU, PEOU, and BI. PU evaluates whether users believe the technology enhances performance; PEOU gauges perceived ease of use; and BI reflects the likelihood of future usage based on these perceptions.

For this study, I adapted the TAM questionnaire into two online instruments—one for students and one for teachers—using a 5-point Likert scale (see Tables 13 and 14 for the

complete item sets). Notably, the neutral midpoint was replaced with the category “I do not know”, following recommendations by Johns (2005), Kulas et al. (2008), and Weems and Onwuegbuzie (2001). This adjustment mitigates issues related to social desirability bias and low respondent involvement, as highlighted by Chyung et al. (2017). The questionnaires were the final data collection tools administered after course completion in Fall 2022 and Spring 2023. Responses were collected from 10 AFL students across five universities and four AFL teachers. Items were adapted from validated instruments in existing literature.

Questionnaire	Section	Construct	Number of Items
Student	Section 1	Perceived Usefulness (PU)	10
		Perceived Ease of Use (PEOU)	9
		Behavioral Intention to Use	2
	Section 2	Additional Evaluation Criteria	Tailored to intervention (not specified individually)
The student questionnaire contained 49 items			

Table 13: Students’ Online Questionnaire

Questionnaire	Section	Construct	Number of Items
Teacher	Section 1	Perceived Usefulness (PU)	10
		Perceived Ease of Use (PEOU)	10
		Behavioral Intention to Use	3
	Section 2	Convenience	7
		Compatibility	4
		Media Richness	7
		E-book Interactivity	5
The teacher questionnaire included 46 items			

Table 14: Teachers' Online Questionnaire

These questionnaires provided a structured and empirically grounded means of evaluating user acceptance and guided the final refinements of the intervention.

Before distributing the questionnaires, my supervisor reviewed the questions to evaluate their

quality. The questionnaire was pilot-tested by one AFL teacher and five AFL students, and minor revisions were made based on their feedback. Teachers received the questionnaire via direct email, while students accessed it through their instructors. A random sampling strategy was employed to avoid bias and enhance generalisability. As Johnson and Christensen (2019) explain, this method is often employed in “a nonexperimental research method in which questionnaires or interviews are used to gather information and the goal is to understand the characteristics of a population based on the sample data” (Johnson & Christensen, 2019, p.249). As Creswell and Clark (2017) stated, “The preferred strategy in quantitative research is probabilistic sampling, also known as random sampling. This method aims to select a significant number of individuals who represent the population or a specific segment of the population” (Creswell & Plano Clark, 2017, p.270). By using this approach, I ensured that the sample was not biased towards a particular group, making the results more reliable and generalisable to the population.

The anonymity of the questionnaire has been deemed an indication of informed consent. The questionnaires were developed and conducted using Qualtrics software to collect and process the responses/data (See appendices 12 and 13). The questionnaires consisted of two sections. Only ten students completed the questionnaire from the four universities, but 100% of the AFL teachers completed the questionnaires.

5.7 Research Context, Sampling Strategies, and Participants

The study was conducted at Site A, a USA branch campus in the Gulf. The global COVID-19 pandemic impacted the initial DBR cycle; lockdowns across educational institutions—the primary research venues—created significant barriers to progress and execution, necessitating the use of qualitative data collection methods via Zoom software. Consequently, data collection unfolded over three years, with initial collection before the first cycle. Semi-structured interviews were recorded, transcribed, and imported into NVivo, software that enabled raw data sorting, visualisation, analysis, and organisation. Through analysis, I identified five to seven themes and codes that addressed the RQs, as recommended by Creswell (2013, p.296). These themes and codes were then utilised in the second DBR cycle to develop the quantitative online survey, with all questions based on themes developed

from the interviews and focus groups conducted during cycle two.

5.8 Data Analysis Techniques

The following section of the current chapter illustrates the data analysis in each cycle of my DBR study. First, I start with a detailed explanation of how I conducted the qualitative data analysis in cycles one and two; secondly, I explain the processes of the quantitative data analysis techniques, and I conclude with the validity and reality of the data analysis.

I employed a reflexive thematic analysis (TA) approach, as described by Braun and Clarke (2022). TA is a flexible method applicable to various qualitative data types, including interview transcripts, focus group discussions, and field notes. Within this reflexive approach, the analysis was conducted using both inductive and deductive orientations. An inductive orientation involves developing themes by working closely with participants' accounts. In line with the reflexive nature of this methodology, themes were not treated as pre-existing entities 'emerging' from the data; rather, I actively identified and constructed them through an iterative and interpretive process. Ultimately, this approach acknowledges that the researcher is an active participant in the creation of knowledge, where themes are generated through a subjective engagement with the dataset (Braun & Clarke, 2022)

5.8.1 Qualitative Data Analysis

This study employed a three-cycle, iterative data collection process. In Cycle 1, qualitative data were gathered through focus group discussions with AFL teachers. Cycle 2 involved semi-structured interviews with AFL teachers and focus group interviews with AFL students. In Cycle 3, quantitative data were collected via online surveys distributed to both teachers and students. Each cycle informed the next, allowing for the refinement of research instruments and a deeper understanding of the intervention's acceptance; this iterative approach enhanced the validity and comprehensiveness of the findings. Following McKenney and Reeves's (2018) recommendations, I applied both deductive and inductive methods to analyse the qualitative data. Interview questions were developed based on established frameworks, including the TAM (Davis, 1989), Passey's (2011) cognitive elements, and Bozkurt and Bozkaya's (2015) IEEC. The deductive approach allowed for

testing the relevance of these theoretical constructs, while the inductive approach enabled the identification of unanticipated themes ensuring that intervention design and subsequent analysis remained theoretically grounded yet empirically responsive.

For Cycle 1, I transcribed audio recordings of the focus group discussions and imported the transcripts into NVivo for thematic analysis. I followed Braun and Clarke's (2022) six-phase process for inductive TA, which facilitates the identification of patterns and themes directly from the data without relying on pre-existing codes or theories. The initial step of data analysis involved familiarisation, in which I became acquainted with the data (Maxwell, 2013) by listening to the recorded audio and repeatedly reading and taking notes using NVivo's annotation tools; this step allowed me to understand the data better and identify initial codes. In the second step, initial codes were generated from the data, and I used the NVivo coding feature to highlight and briefly describe these codes. To organise participants' answers efficiently, I established nodes based on the TAM framework. In the third step, I grouped the codes to identify potential themes by re-coding replies within each node according to research-question relevance. In the fourth step, I reviewed and refined themes, merging or splitting them and redefining boundaries as required, with NVivo visualisations supporting this process and clarifying relationships among subthemes.

In the fifth step of the analysis, I focused on identifying and categorising themes that captured overarching patterns while aligning them with the RQs and the focus-group question guide to ensure coherence. The final step involved reporting the themes through a detailed account of findings supported by direct quotes or examples from the data, thereby bolstering the clarity and validity of the results.

In the second cycle of my research, I repeated the same steps as the first, conducting semi-structured and focus group interviews with AFL teachers and students consecutively. However, in the fifth step of data analysis, I aimed to identify and name the themes that captured the overall patterns and trends within the data by utilising the TAM framework proposed by Davis (1989), Passey's cognitive elements (2011), and the IEEC established by Bozkurt and Bozkaya (2015), as well as the interview question guides. By aligning the themes with these frameworks and question guides, I gained a better understanding of the

data. I was able to draw meaningful conclusions that informed subsequent survey construction and the overall evaluation of the intervention.

5.9 Transcription of Cycles One and Two Data

After conducting focus groups with AFL teachers, sessions were audio-recorded for future reference and analysis. Interviews were conducted in Arabic and translated into English. I utilised NVivo software, a qualitative data analysis software, to identify patterns using text and word-matching queries.

Using NVivo proved beneficial for visualising, analysing, and organising data accessibility. Annotating interview scripts enriched the analysis and facilitated the identification of overlapping themes. NVivo also enhanced transparency across DBR stages, including coding and identifying the most frequently encountered themes.

Semi-structured interviews with teachers and focus group discussions with 17 students were conducted in English, and both were recorded using Zoom software. The recordings were transcribed using Microsoft 360, and the transcripts were thoroughly reviewed for accuracy. After transcription, NVivo was used again, following the same procedure as in the previous cycle.

5.9.1 Quantitative Data Analysis

In Cycle 3, questionnaire data exported from Qualtrics into IBM SPSS (version 26) were analysed. The student and teacher instruments adapted the TAM items, structured into PU, PEOU, and BI constructs on a five-point scale, where the neutral midpoint was replaced with “I do not know”. Data preparation involved harmonising the coding of positively phrased items, treating “I do not know” as a distinct response, and grouping items under their respective constructs for reporting. Descriptive analyses—frequencies and percentages—were conducted at item and construct levels to characterise acceptance and user experience of the refined e-book, consistent with the study’s purpose and modest sample size. These procedures reflected the instrument structure, administration, and data collection timing (Fall 2022 and Spring 2023). Instrument quality was supported through expert review and piloting prior to administration, and interpretation was anchored in the established reliability and

validity of the TAM constructs reported in prior work; the quantitative patterns were then triangulated with the qualitative insights from Cycles 1–2 to inform iterative design decisions within the DBR process.

5.10 Data Triangulation

The present study utilised semi-structured interviews, focus groups, and online questionnaires to collect data for the DBR study. Employing these methods ensured data triangulation, providing a robust data set and increasing the reliability and validity of the findings (Johnson & Christensen, 2019; Marshall & Rossman, 2014). Methodological triangulation employs multiple methods to explore a research question; Morse (1991) identifies two forms — simultaneous and sequential. In the current study, I utilised the latter form: results from semi-structured interviews with AFL teachers and students guided the approach and interpretation of the open-ended online questionnaire.

Prior studies that utilised the TAM questionnaire have established the reliability and validity of the PU and PEOU (Davis, 1989; Venkatesh & Davis, 2000), providing a strong foundation for the present study’s use of the TAM to assess participants’ perceptions of new technology. Data triangulation enabled cross-validation across sources, increasing the robustness of the conclusions and enriching interpretation to guide iterative design decisions.

5.11 Ethical Considerations

The proposed thesis study underwent ethical approval from two bodies. Firstly, it was reviewed by Lancaster University’s Research Ethics Committee, as required for all doctoral students who collect personal data or conduct research involving human participants. Secondly, the study was reviewed by the Site A IRB to ensure compliance with ethical requirements in research standards. Before collecting data, all participants were required to sign informed consent forms during cycle one (focus group interviews with teachers) and cycle two (semi-structured interviews with teachers). This was to ensure compliance with IRB regulations and procedures. In cycle three, the consent form was integrated into the online questionnaire.

Moreover, participants were informed that they voluntarily participated in the study and

could withdraw at any point without facing negative consequences or penalties. Upon approval, each participant received an information sheet detailing the research methods and acknowledged that the interviews would be recorded, transcribed, and stored in a secure, password-protected computer (see Appendix 6). A copy of the consent form appears in Appendix 7. Furthermore, they were informed that all data collected would be anonymised, analysed, and published. This information was provided to ensure that the participants fully understood their rights and the terms of their participation in the study.

5.12 Generalisation

This DBR study does not claim statistical generalisation; instead, it seeks analytic generalisation and transferability. Credibility is strengthened through methodological triangulation across interviews, focus groups, and questionnaires, enabling convergence of evidence and cross-validation of findings. Breadth is enhanced by sampling teachers and students from multiple institutions in Qatar, the US, Denmark, and Canada, providing heterogeneity of contexts. In the quantitative phase, probabilistic (random) sampling was adopted where feasible, to reduce selection bias and increase confidence that inferences may extend to similar populations.

5.13 Chapter 5 Summary

According to Barab and Squire (2004), the iterative approach in DBR helps researchers design interventions that improve educational practices by applying their experiences to enhance the learning and teaching processes.

The study employed a sequential exploratory mixed-methods design across the three DBR cycles to collect both qualitative and quantitative data. I employed a mixed-methods approach, involving three distinct data collection methods in this study. These methods included focus group interviews during cycles 1 and 2, semi-structured interviews during cycle 2, and online questionnaires during cycle 3. The study employed both deductive and inductive approaches to analyse qualitative data, integrating existing theoretical frameworks with emergent insights. The deductive approach assessed the relevance of established theories, while the inductive method uncovered themes beyond initial frameworks. Thematic

analysis followed Braun and Clarke's (2022) six-step process: data familiarisation, initial coding, theme identification, review, definition and naming, and writing up the findings.

Chapter 6: Results

6.1 Chapter Overview

In this chapter, I provide an overview of the findings from the DBR study. The study employed a sequential mixed-method design, collecting qualitative data during the first and second cycles, followed by quantitative data during the third cycle. This chapter is structured around specific RQs, each of which is addressed using distinct data types. Initially, exploratory focus groups with eight teachers identified key challenges and informed the development of a prototype intervention. In the second cycle, semi-structured interviews were conducted with five teachers and focus group discussions with 17 students, capturing their perceptions of a digital e-book for teaching the Arabic alphabet. The final cycle involved online surveys with five teachers and 30 students to assess their acceptance of the e-book.

The findings are presented thematically through themes and sub-themes identified and developed during analysis, which are in turn used to answer the RQs. The study's results were highly informative and shed new light on the potential of digital tools for effective Arabic alphabet teaching.

6.2 Cycle 1: Findings of the Exploratory Focus Group

The initial phase of this research involved conducting two one-hour exploratory focus group discussions using Zoom software with eight experienced educators from various universities. These discussions aimed to explore AFL teachers' challenges as they shift to online teaching and the ideal digital tool for teaching the Arabic Alphabet online. The analysis was based on the following RQs:

RQ1: What challenges are encountered in teaching the Arabic writing system?

RQ2: What digital tool would be ideal for teaching the Arabic writing system?

Upon analysing the data thematically, I identified four key themes. The first two themes and their sub-themes were relevant to the first research question, while the remaining two themes and their sub-themes were identified in relation to the second research question. In the

following sections, I will preview the key themes and sub-themes identified during the data analysis and coding of the focus group discussions with Arabic teachers.

6.2.1 RQ 1: Challenges Arabic Teachers Faced

Regarding Research Question 1, which sought to explore the challenges encountered in teaching the Arabic writing system, the objective was to investigate the difficulties that AFL teachers faced in teaching the Arabic writing system. To achieve this, I conducted a TA of the qualitative data collected from focus group discussions. Table 15 presents the analysis summary, identifying two overarching themes and seven sub-themes.

In the focus group discussions, I identified ‘Technology Overwhelms Teachers and Students’ as the first key theme, comprising three sub-themes: the shift from in-person to online learning; overwhelming training sessions; and technical difficulties. The second theme, ‘Challenges of Teaching the Arabic Alphabet Online,’ included four sub-themes: monitoring writing; monitoring pronunciation; time-intensive feedback; and student engagement.

RQ1: What challenges are encountered in teaching the Arabic writing system?	
Themes	Sub-themes
Theme 1: Technology Overwhelms Teachers and Students	Sub-theme 1.1: Transition from Face-to-Face to Online Sub-theme 1.2 Overwhelm Due to Workshops and Training Sub-theme 1.3 Technical Issues
Theme 2: Online Arabic Alphabet Teaching Issues	Sub-theme 2.1: Tracking Students’ Writing Sub-theme 2.2: Tracking Students’ Pronunciation Sub-theme 2.3: Time-Consuming Feedback Processes Sub-theme 2.4: Student Engagement

Table 15: Themes and Subthemes Identified for Research Question 1

6.2.1.1 Theme 1: Technology Overwhelms Teachers and Students

The transition to online teaching has been particularly challenging for educators and students. Many participants felt overwhelmed by the abundance of workshops and training sessions to improve online teaching skills. In addition, introducing multiple software solutions shifted the focus from teaching and learning to mastering digital tools. This was compounded by technical challenges that helped create the perception that online teaching was more time-consuming than traditional methods.

6.2.1.1.1 Sub-theme 1.1: Transition from Face-to-Face to Online Teaching

The sudden transition from F2F to remote teaching created challenges for AFL instructors, especially in teaching the Arabic alphabet and its sounds, as they adapted their pedagogical practices to the virtual environment. The rapid pace intensified the challenges, forcing modifications in teaching methods. Participant 1 struggled with Zoom's Whiteboard, finding it hard to write with a mouse or fingers, and instead used a physical whiteboard with Zoom mirroring. He explained that "one of the problems is enabling the student to write the letter that they are learning for the first time." Due to similar issues, Participants 1 and 4 shared screenshots of their handwriting, which confused students who thought Arabic letters should be drawn rather than written. Participant 1 added: "The problem is more with writing than with evaluation." Participant 2, who used a stylus, could deliver lectures effectively, yet many students lacked stylus devices, relying on finger writing or screenshots that delayed feedback. He noted:

I didn't ask my students to have a tablet, iPad, or stylus because I wasn't aware of their financial situation. Instead, we used Zoom and a whiteboard for writing purposes. However, it was challenging to identify every mistake the students made during the session. (P2)

Participant 3 highlighted the lack of differentiation online, noting that F2F group work allowed stronger students to support peers: "I found that F2F learning through activities such as group work and imitating others was beneficial for me. To tailor to individual differences between students, we encouraged fast learners to help their peers." Participant 4 indicated that online alphabet teaching required more time to achieve objectives than effective in-person instruction, while Participant 3 reflected: "While F2F learning could take up to 10 minutes to achieve a goal, online learning has allowed us to reach our objectives more efficiently, with tasks taking only half an hour or an hour."

Similarly, Participant 6 noted the added difficulty and time of online teaching: "It is not uncommon for a lesson objective that would take 10 minutes to teach F2F to require 20 to 30 minutes online. I found out that I used English in online classes more than in F2F classes."

6.2.1.1.2 Sub-theme 1.2: Overwhelmed Due to Workshops and Training

The shift from traditional F2F to online teaching was a complex and challenging process involving various aspects and stages. Participant 5 explained how online instruction could shift focus away from actual teaching and learning towards mastering digital tools: “Keeping up with technology is beneficial for the human brain, but it requires time, energy, and preparation. It is essential to be aware of potential problems that may arise.”

Participant 6 echoed a similar statement: “The burden on the teacher is to become familiar with a new program, and on the student is to learn how to use it.” The participants noted attending online workshops focusing on using various software and platforms for online teaching, as shown in Table 16.

The tool/applications/ platforms	Functioned / associated Features
Notability Application	Note-taking and annotation
Canvas, Google Classroom, Manage back and Blackboard	Learning Management System (LMS) and course organization
Mastering Arabic Website	Interactive language learning resources
The whiteboard on Zoom and mirroring the screen	Real-time visual demonstration and instruction
The textbook combined with the website	Supplemental digital content
Zoom application, Microsoft Teams, Webex and Google Meet	Video conferencing and breakout sessions

Table 16: Software and Platforms for Online Teaching

6.2.1.1.3 Sub-theme 1.3: Technical Issues

Participants reported that poor internet connectivity disrupted access to learning materials, complicating the online learning process. Tasks such as submitting and reviewing writing assignments became more time-consuming. AFL instructors also faced difficulties providing feedback using a computer mouse, as the stylus—a more effective tool—was not yet fully adopted due to the abrupt transition to remote teaching. Moreover, unstable Internet connections hindered clear communication during online classes, adversely affecting the learning experience.

Participant 3 noted: “When teaching F2F, and you see the student’s mouth and movements, it’s, of course, easier to produce the sound as it should be. But online, it is difficult, with poor

internet; sometimes, some students have connectivity issues.”

6.2.1.2 Theme 2: Online Arabic Alphabet Teaching Issues

Further analysis showed that participants noted online learning could be challenging when monitoring student progress. This was particularly true for tracking students’ writing style from right to left and monitoring the pronunciation of Arabic sounds unique to the Arabic language.

6.2.1.2.1 Sub-theme 2.1: Tracking Students’ Writing

In classroom settings, teaching handwriting often presents challenges, particularly in mechanics. Students are instructed to hold the pen correctly and write from right to left, and they can see the teacher’s hand and writing demonstrations clearly. However, online classroom positioning often impedes their view of the teacher’s demonstrations, limiting their understanding of writing techniques. At the same time, teachers struggle to observe students’ hand movements and direction, making it difficult to provide timely and accurate feedback. This lack of visibility hinders both teaching and learning processes. Participant 5 explained that while students can see the teacher’s writing, “the teacher cannot observe the student’s writing as effectively as in a physical classroom.”

6.2.1.2.2 Sub-theme 2.2: Tracking Students’ Pronunciation

Teaching pronunciation and listening skills online were major challenge for focus group teachers. Ensuring pronunciation quality was particularly difficult due to frequent Internet disruptions. Consistent monitoring is essential for effective language acquisition, especially at the elementary level. Poor connections frequently required repeated instructions, hindering progress. As Participant 8 put it:

The most significant thing is monitoring the precision of articulation points. When the student is in front of you, you can see and adjust the articulation, noticing subtle differences. Online, you might hear them, but not as well as in person. How would you adjust nasal articulation and other aspects? (P8)

Echoing a similar sentiment, Participant 10 stated: “The problem of how to hear the sound...

Phonetics in the Arabic language has almost ten articulations.”

6.2.1.2.3 Sub-theme 2.3: Feedback Processes

Providing instant feedback, particularly on written assignments, considered as a concern in online classes. Focus group participants emphasised that immediate feedback on writing and pronunciation was crucial for effective teaching and learning, yet it was more challenging to deliver online than in-person.

Participant 1 mentioned: “The advantage of classroom learning is feedback. It is more valuable than online feedback. The classroom makes the students more engaged, and they grasp the information better. It is all about the feedback and the student’s progress in learning.”

The absence of instant feedback complicates teaching—correcting writing mechanics is easier when instructors can provide immediate input. Teachers often cannot observe students’ hand movements or writing direction online, which hinders timely, accurate feedback and can cause misunderstandings. A related issue arises when feedback is requested on Arabic letters presented as images rather than text; this approach may undermine teaching and result in a weak assessment of handwriting.

Participant 2 articulated, “Students have struggled with writing since the pandemic started, and our classes moved online. She sends me pictures of her work via WhatsApp. Despite the availability of good technological tools, it’s still challenging to provide the necessary feedback.”

From experience, the shift to platforms created further challenges; submitting typed rather than handwritten assignments risks eroding proficiency in Arabic handwriting because students may over-rely on auto-correction. While quizzes are indispensable for evaluating and reinforcing AFL learning objectives, maintaining academic integrity online remains a significant challenge.

6.2.1.2.4 Sub-theme 2.4: Student Engagement

AFL teachers reported challenges in maintaining student engagement during online classes,

raising concerns about the overall effectiveness of remote learning. They noted a lack of engaging activities, such as interactive games to support Arabic letter acquisition, which diminished the learning experience. Additionally, participants questioned the efficacy of collaborative learning methods, such as pair or group work, particularly when using Zoom breakout rooms. Difficulties in communication, coordination, and peer interaction often hindered the intended learning outcomes.

Participant 3 noted: “Break-out rooms are a useful but have limitations. Mainly, that teachers cannot monitor multiple rooms simultaneously, which can be a challenge.”

6.2.2 RQ 2: Suggestions for Dream Digital Tools

The TA of focus group data addressing RQ2- “What is your dream digital tool you wish to have to teach the Arabic writing system?”—revealed two main themes and related sub-themes (see Table 17). The first theme pertained to design preferences, encompassing interactivity, real-time feedback, and customisability. The second theme focused on pedagogical preferences, including general suggestions and activity types.

RQ2: What is your dream digital tool you wish to have to teach the Arabic writing system? Please tell me what, why, and how.	
Themes	Sub-themes
Theme 3: Design Preferences of the e-Book	Sub-theme 3.1: Interactivity Sub-theme 3.2: Real-Time Feedback Sub-theme 3.3: Customisability
Theme 4: Pedagogical Preferences	Sub-theme 4.1: General Suggestions Sub-theme 4.2: Activity Types

Table 17: Themes and Subthemes Identified for Research Question 2

6.2.2.1 Theme 3: Design Preferences of the e-Book

Under the umbrella of “design preferences”, the sub-themes of interactivity, real-time feedback, and customisability were identified as critical areas of interest.

Interactivity refers to how much an e-book allows for user engagement. Real-time feedback pertained to providing timely and relevant information to the reader, which could enhance

the learning and comprehension process. Finally, customisability was concerned with the ability to tailor the e-book to the individual reader's preferences and needs.

6.2.2.1.1 Sub-theme 3.1: Interactivity

Focus group discussions with teachers highlighted the importance of interactivity in e-books. Interactivity is reported to promote user engagement and active learning through multimedia content and tasks (El-Sabagh, 2021). Teachers in my study suggested incorporating interactive writing tools and visual/audio aids. Specifically, interactive writing tools were essential for teaching Arabic script, with GIFs providing guidance and immediate feedback on letter formation.

Participant 7 described the difficulties in online teaching compared to traditional classes, specifically in not being able to observe students' writing orientation: "I face difficulties in online teaching compared to traditional classes. I cannot know where the student starts writing – right, left, top, or bottom – which I know when I teach in person."

Participant 8 said: "The e-book itself makes the student write the letter on the screen, i.e., it gives the direction of the arrow and tells him [the student] to go this way and then come back this way."

The use of visual/audio aids is another interactive element that can enhance online learning. These aids help students understand and retain information more effectively. For instance, a student watching a video of writing a letter while hearing the correct pronunciation can better grasp the nuances of the language. This approach addresses the limitations of online teaching, where students may not always have clear, real-time access to visual cues from their instructors.

Participant 6 strongly preferred using videos in teaching: "I am very biased towards using videos in education", while Participant 5 highlighted the role of videos in illustrating mouth shapes for pronunciation, noting that they served more as explanation than training. Such videos display the mouth shape while pronouncing the sound, emphasise directions, and present the process slowly.

6.2.2.1.2 Sub-theme 3.2: Feedback System

Real-time feedback is essential for effective learning, yet more difficult to achieve in online environments than in traditional classrooms, where teachers offer immediate corrections and guidance. Focus group discussions highlighted concerns about student engagement and the adequacy of feedback in online settings, particularly for writing tasks. To address this, teachers recommended incorporating live annotation tools and instant messaging to sustain educational quality and reinforce correct techniques. Indeed, Participant 4 underscored the superiority of classroom feedback over online alternatives:

The greatest thing about the classroom is feedback, which is more beneficial than online feedback. In-person interactions engage students' memory better, helping them grasp information and learn more effectively. Ultimately, classroom learning is superior due to the focus on feedback and student progress. (P4)

Participant 1 highlighted the potential benefits of real-time feedback for online university students: “Having a feature like this [real-time feedback] for students at the university, given that we are online, will compensate us for being with the students at the university, not knowing how they write.” Participant 8 mentioned the limitations of evaluating students’ writing in online learning compared to in-class settings: “In online learning, the teacher cannot evaluate the student’s writing as he can in class.”

Participant 4 reflected on the adjustments and needs in online classes, emphasising follow-up and instant feedback: “Follow-up in online classes becomes easier as we adjust to the situation. Instant feedback and activating self-learning are needed.”

6.2.2.1.3 Sub-theme 3.3: Adaptive e-learning

Adaptive e-learning enables teachers and students to personalise the learning process to meet their specific needs and preferences better, improving overall effectiveness and engagement in education. It also enhances online learning quality by delivering customised content to individual learners (El-Sabagh & Hamed, 2020).

Participants expressed interest in a customisable e-book that would allow them to add or modify content to align with their teaching style and curriculum. Customisability encompasses various aspects, including flexibility in the learning path, selecting different feedback modes, integrating interactive elements suitable for different learning preferences and Offline and Online Accessibility, as shown in Figure 25.

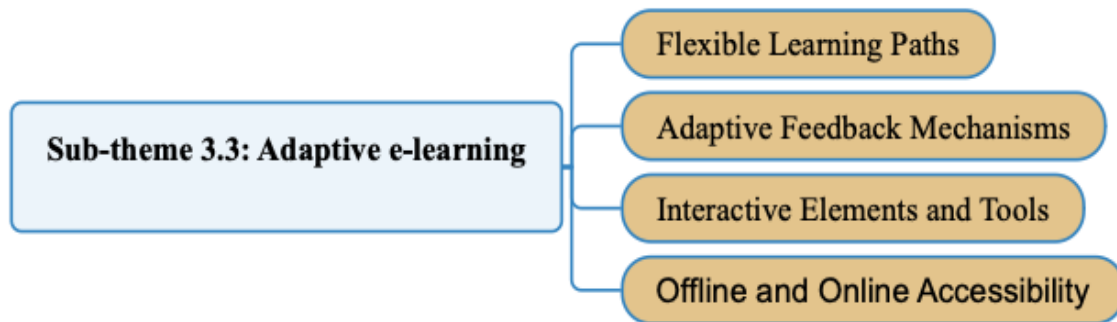


Figure 25: Sub-theme 3.3: Adaptive e-learning

6.2.2.1.3.1 Flexible Learning Paths

Customisability provides flexible learning paths, allowing students to progress at their own pace and choose topics based on their proficiency and confidence. For example, students who know Urdu or Farsi can skip to more challenging material rather than following a predefined sequence. Participant 3 said: “It can involve self-learning, allowing students to choose which letters to focus on.” Students using an e-book independently can seek a personalised self-learning experience. Participant 6 articulated: “Especially now, there is the alternative of activating self-learning or independent learning even within a framework like a reference framework.” Participant 6 said: “I want to use and benefit from the e-book as a self-learning resource independently, without being associated with a particular institution or teacher. I want this self-learning aspect to be distinct and personalised.”

6.2.2.1.3.2 Adaptive Feedback Mechanisms

Customisability also involves providing adaptive feedback tailored to individual student needs. This consists of incorporating automated feedback from the application and personalised feedback from teachers. As Participant 6 noted, integrating technology to

facilitate feedback is essential: “I believe it would be more efficient for students to have an account that collects all their progress and sends just one email at the end of the learning session rather than generating an email for each short activity.”

Participant 5 mentioned: “Under normal conditions of learning letters, the teacher had to monitor the students while they practised continuously.”

6.2.2.1.3.3 Interactive Elements and Tools

Incorporating interactive elements—digital worksheets, videos and adaptive quizzes—is another aspect of customisability; these can adjust difficulty to student performance, increase engagement, and allow learners to interact with content according to their preferences. Participant 3 suggested demonstration videos:

I wish there were a video showing how to pronounce and write the letter, including its direction. I mean, not just a picture because most people show you a picture, and the student doesn't know how this letter was written before. (P3)

Participant 2 recommended animation for pronunciation, noting: “An animated cross-sectional image of the vocal apparatus showing airflow movement would be really useful.” Participant 2 also recommended visual aids for stroke direction: “When the line runs, students see this line. It shows the direction and is supposed to be next to a small board where you can write with your finger or a pen.”

6.2.2.1.3.4 Offline and Online Accessibility

Participants wanted a tool that functions offline, providing flexibility for students with limited Internet access. Offline functionality ensures students can learn without a connection. Participant 5 emphasised the need for online and offline access: “If a student doesn't have internet access and wants to use the application, it should be able to be used offline, while there should also be an online aspect for competitions.” Participant 1 mentioned: “It is a good idea that some of the exercises will be offline while others need to be online.”

6.2.2.2 Theme 4: Pedagogical Preferences

This theme, ‘Pedagogical Preferences’, was extensively discussed, revealing two distinct sub-themes: ‘General Suggestions’ and ‘Activity Types’. The focus group discussions provided insight into the pedagogical approaches desired in a digital tool that facilitates the teaching and learning of the Arabic writing system. In addition, the discussions extended to the various suggested activities that helped learners improve their Arabic writing skills.

6.2.2.2.1 Sub-theme 4.1: General Suggestions

As shown in Figure 26, the focus group participants suggested that students could select their preferred teaching approach for learning the Arabic alphabet. This could involve learning the stand-alone Arabic alphabet in its traditional order or grouping the letters based on pronunciation. They also suggested relevant, everyday vocabulary examples in the e-book based on communicative phrases for each group of letters. Additionally, they recommended dividing lessons into letter recognition, handwriting practice, and assessments.

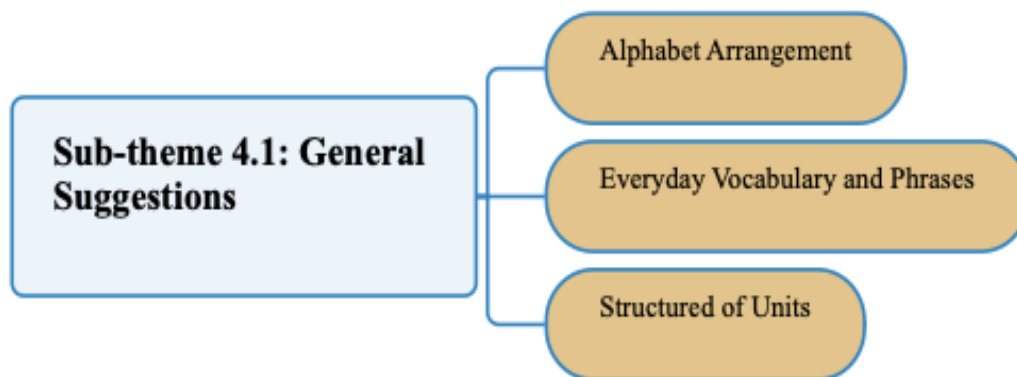


Figure 26: Sub-theme 4.1: General Suggestions

6.2.2.2.1.1 Alphabet Arrangement

Participant 5 explained that the pronunciation of a letter depends on the approach being used, particularly whether it is based on the place of sound articulation taught commonly to Arabic students for religious purposes. He mentioned:

The sound of each letter varies based on the context, particularly for Arabic students learning

Qur'anic recitation. The first oral letters are the *ba*, the *meem*, the *fa*, and the *waw*. After that, we introduce the guttural letters individually inside the vowel letters *hamza*, *ha*, *ain*, *ha*, *ghayn*, and *ta*. (P5)

Participant 3, by contrast, recommended arranging the standard Arabic alphabet using the dot system — based on letter shape and dots — as a universally suitable ordering for learners. “As for the external pronunciation, grouping the letters by dots and shapes is suitable for everyone.”

6.2.2.2.1.2 Everyday Vocabulary and Phrases

Participants also recommended that the vocabulary examples in the e-book be relevant to everyday life. They highlighted the need to present each group of letters with communicative phrases that students can use or personalise in their daily interactions.

Participant 6 stressed the importance of simplifying content, intensifying activities, and maintaining authenticity to cater to students' independent learning needs: “Every group of the alphabet letters presented to the student must have a communicative function with phrases they can use in daily life.”

6.2.2.2.1.3 Structure of Units

Finally, they recommended dividing the lessons or units into three parts: letter recognition, letter practice, and assessments to test their learning outcomes.

Participant 6 noted: “Lessons should rely on the idea of the student's reception, whether auditory or reading level, and reproduction or rather practice of reproduction.”

6.2.2.2.2 Sub-theme 4.2: Activity Types

During the focus group discussions, participants evaluated digital tools for teaching the Arabic writing system, highlighting several practical activities for educators and learners. Suggestions included interactive guessing games, mechanical drills, and sound-enabled flashcards, with auditory elements considered to enhance phonetic understanding. Recording students' voices and providing immediate feedback, via the e-book or the teacher, was

emphasised as essential. Gamification features—memory games and point collection—were cited for boosting engagement. Listening and practice tasks, word searches, and memory activities linking isolated letters to words supported cognitive development, while reading and word-to-sound matching tasks with answer submission promoted active learning and improvement. Finally, quizzes were regarded as indispensable for assessing and reinforcing learning objectives.

6.3 Cycle 2: Findings of the Individual Semi-Structured Interviews with Teachers

In the second cycle of this DBR study, I conducted individual semi-structured interviews with five AFL teachers to obtain their perceptions of the e-book for teaching the Arabic alphabet. The data collected from these interviews were analysed using NVivo software (see Appendices 8 and 9) to identify themes and sub-themes related to the following RQs.

RQ 3: What are AFL teachers' perceptions of using the AFL interactive e-book to teach the Arabic writing system?

RQ 4: What are the teacher challenges related to the AFL interactive mobile e-book's PEOU and PU?

For RQ 3, which investigated AFL teachers' perceptions of the interactive e-book for teaching the Arabic writing system, the principal theme was BI, shaped by PEOU and PU. Teachers expressed generally positive attitudes, noting that the e-book's usability and usefulness strongly influenced their willingness to adopt it in instruction.

RQ 4 examined teacher challenges with PEOU and PU, which clustered into two categories: pedagogical and technological. Pedagogical challenges involved adapting activities to students' needs, improving feedback, and providing more explicit instructions, emphasising the value of student-centred approaches. Technological challenges concerned the interface, functionality, and multimedia features; teachers highlighted the need for improved accessibility and navigation (bookmarking, search, note-taking) and for more usable multimedia—particularly sound and colour. Teachers recommended enhancing functionality, navigation, and multimedia design while aligning activities with learning objectives, clarifying instructions, and strengthening feedback to improve the learning

experience.

6.3.1 RQ 3: Teachers' Perceptions

Responding to RQ 3: "What are AFL teachers' perceptions of using the AFL interactive e-book to teach the Arabic writing system?", teachers' perceptions, user behaviour intentions, and two sub-themes, PEOU and PU, were identified, as shown in Table 18.

RQ3: What are AFL teachers' perceptions of using the interactive e-book to teach the Arabic writing system?	
Themes	Sub-themes
Theme 1: Teachers' Perceptions User's Behaviour Intention (BI)	Sub-theme 1.1: Usefulness Sub-theme 1.2: Ease of Use

Table 18: Themes and Subthemes Identified for Research Question 3

6.3.1.1 Theme 1: Teachers' Behaviour Intentions

Participants provided positive feedback about the Alif Ba'a e-book. They found it beneficial for students in the early stages of learning the Arabic writing system and those who preferred self-directed study. The e-book was also valued for both home study and classroom instruction. Participants appreciated its multimedia elements and user-friendly interface. Participants emphasised the significant impact of the e-book's helpfulness and user-friendliness on their intention to incorporate it into their teaching methods. The following summarises how AFL teachers used the Alif Ba'a e-book: they found it useful and easy to use.

6.3.1.1.1 Sub-theme 1.1: Usefulness

The AFL teachers found the Alif Ba'a e-book particularly useful for students in the early stages of learning the Arabic writing system. Participant 3 noted: "It's very useful for a beginner, especially in the first weeks when they are just, they know nothing." This highlights the e-book's role in supporting learners in the initial phase of language learning.

Additionally, the e-book proved beneficial for late joiners and autonomous learners. As Participant 1 explained: "It's particularly useful for latecomers and autonomous learners", pointing to its flexibility in accommodating different learner needs.

The e-book also supported home study and interactive classroom teaching. Participant 4 emphasised: “It is useful for the students to study at home and also for the teacher to show them in the class with interactive things.” Participants further valued its multimedia features, such as the imitation of Arabic writing and the inclusion of human sound. Participant 2 remarked: “Everything about multimedia is great... The letters mimic Arabic writing from right to left. And then. The fact that human sound is provided to help the students with pronunciation and tongue shape.” This appreciation highlighted the e-book’s effectiveness in enhancing the learning experience through multimedia.

6.3.1.1.2 Sub-theme 1.2: Ease of Use

The semi-structured interviews yielded highly insightful results, indicating that teachers exhibited positive attitudes towards the e-book’s usability. AFL teachers noted that the e-book excelled in user-friendliness, navigation, and organisation. They emphasised that it was user-friendly and easily navigable without expert knowledge, underscoring the simplicity and accessibility of its interface. Among the comments made were:

The interface is very friendly. I liked it, and it’s easy to use. As I said earlier, it’s accessible. It doesn’t require extra expertise. (P3)

The flashcards and other e-book features are easy to use. (P5)

It’s very easy to use. I didn’t encounter any issues. (P4)

The straightforward navigation within the e-book was also appreciated, as Participant 3 explained: “Navigating through the entire book or just one chapter... was so easy using the bar on the left side.”

The e-book’s interface was consistently described as user-friendly and easy to navigate:

The book is very organised. You can easily expect to find the letter you want. (P2)

This consistent feedback emphasised the user-friendly nature of the e-book, making it accessible and straightforward for all users.

6.3.2 RQ 4: Challenges Arabic Teachers Faced After Using the E-book

Following the second DBR cycle, AFL teachers participated in semi-structured interviews and provided feedback on RQ4, which examined challenges of using the AFL interactive e-book and its associated PU. Three themes with sub-themes specified as shown in Figure 27: (1) pedagogical issues—language activities, feedback, and instructions; (2) technology problems—e-book interface and functionality; and (3) multimedia aspects—absence of audio activities, offline access, and multimedia integration. Participants reflected on difficulties they faced and offered recommendations for improving the e-book in the next stage.

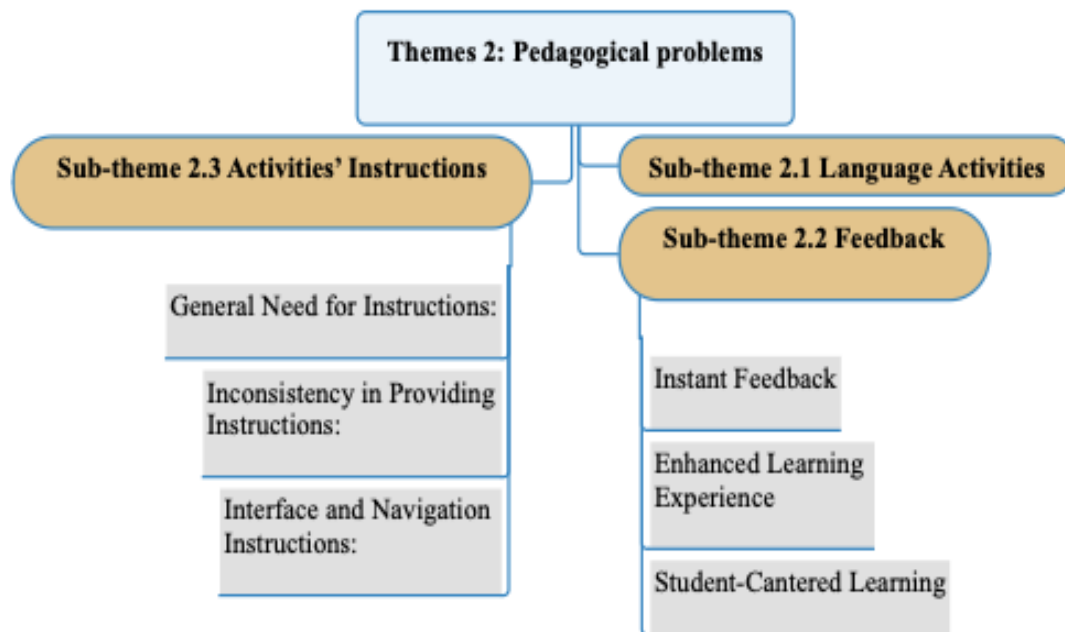


Figure 27: Themes and Subthemes for Research Question 4

Four participants used the e-book to introduce the Arabic alphabet; one used it only after presenting the alphabet, noting: “Next year, since it’s ready now, I could integrate it much earlier.” Another used the e-book alongside supplementary materials: “I did incorporate it with other materials, but it was a big share of my class.” Participant 4 said that he used the e-book instead of the main textbook: “I don’t ask my students to buy a specific textbook because it’s too expensive for just one month, but I use it as a resource. I adopted similar content from the Alkitaab without asking them to purchase it.”

6.3.2.1 Themes 2: Pedagogical Problems

AFL teachers identified several pedagogical challenges that impacted language learning while using the e-book. These challenges were categorised into sub-themes related to language activities, feedback mechanisms, and activities' instructions, as shown in Table 19.

RQ 4: What are the teacher challenges related to the AFL interactive mobile e-book's PEOU and PU?	
Themes	Sub-Themes
Theme2: Pedagogical Problems	Sub-theme 2.1 Language Activities Sub-theme 2.2 Feedback Sub-theme 2.3 Activities' Instructions
Theme 3: Technology Preferences	Sub-theme 3.1 E-book Interface Sub-theme 3.2 E-book Functionality
Theme 4: E-book Multimedia problems	Sub-theme 4.1 Absence of Audio Activities Sub-theme 4.2 Offline Access Sub-theme 4.3 Multimedia Integration

Table 19: Pedagogical Problems

6.3.2.1.1 Sub-theme 2.1 Language Activities

There were different views regarding the language activities used in the e-book. A key issue raised was the simplicity of language activities. Participant 3 noted that although they appreciated the variety of activities, they were too simple and should be more challenging for students: “Many activities I like that I appreciate providing many activities, but sometimes they were very simple.” This simplicity could hinder engagement and progress, indicating a need for more complex and stimulating tasks.

Moreover, Participant 4 emphasised the importance of organising vocabulary thematically—such as adjectives, numbers, and household items—to enhance learning. He explained: “I have 100 new words in the alphabet, classified by themes. For instance, adjectives include جديد وطويل (jadeed wa-taweel) [new and long]. There’s also a theme for numbers, covering 1 to 20.”

Participant 1 expressed mixed views, suggesting some activities might be unnecessary: “Some of them I liked; some of them, to be honest, I didn’t use them because they seemed pointless.”

6.3.2.1.2 Sub-theme 2.2 Feedback

AFL instructors expressed concerns about feedback and emphasised several key aspects, including instant feedback, improved learning experience, and student-centred learning.

6.3.2.1.2.1 Instant Feedback

Participants believed that instant feedback enabled students to identify mistakes as they occurred, allowing immediate correction. This reinforced correct information while the error was still fresh in the student's mind. Although interactive exercises already offered such feedback, participants wanted the feature extended to all tasks. Participant 2 stated: "I believe instant feedback from the software so that students know what their mistakes are." Similarly, Participant 4 observed: "It's only until you finish all of them that you figure out what your mistakes are, and this is a point of weakness", highlighting the importance of immediate feedback to prevent uncorrected errors.

6.3.2.1.2.2 Enhanced Learning Experience

Participants believed that providing instant feedback improved learning by enhancing interactivity and engagement. When students received immediate feedback on correct answers, it boosted their confidence and motivation. As noted by Participant 4: "When they do a good word, they get the right feedback." Participant 5 also emphasised the beneficial impact of instant feedback, stating: "You get instant feedback. This is also seen so nice, so that was good."

6.3.2.1.2.3 Student-Centred Learning

Participants emphasised the importance of instant feedback in fostering a student-centred learning approach. Participant 1 stated: "For a completely student-centred material, instant feedback is essential so that students are aware of their mistakes." Participant 4 similarly remarked: "These are two examples to show you why we need it to be more student-centred from the beginning so that they receive their feedback without help." Participant 3 added: "This is for the student to try at home, then you need to change it to be more student-centred." This underscored the importance of feedback mechanisms that supported students' needs and

encouraged self-directed learning.

6.3.2.1.3 Sub-theme 2.3 Activities' Instructions

A critical sub-theme pertained to the activity instructions within the pedagogy challenge's theme. Participants expressed concerns about several issues related to the instructions for activities, including the general need for instructions, inconsistency in providing instructions, detailed instructions for specific types of activities, and interface and navigation instructions.

6.3.2.1.3.1 General Need for Instructions

Participants consistently emphasised the necessity of clear and detailed instructions accompanying all e-book activities to ensure students understood both the purpose and process of each task. Participant 4 highlighted: "The students need to have some instructions for activities, how they are used and done." Similarly, Participant 5 stressed the importance of accurate guidance: "Because the instructions were incorrect? It was not like that. You did not provide guidance on what they are supposed to do or what you expect from them."

6.3.2.1.3.2 Inconsistency in Providing Instructions

The participants raised concerns about the inconsistency in delivering instructions. In the prototype version, some activities included directions while others did not, creating confusion and uneven experiences. Participant 5 noted: "Some activities have instructions, while others do not. A student might see a line like, 'Write the following words and send them to your teacher'. Some do not have instructions." This highlighted the need for clear, detailed guidance specifying what students should do in each task. Participant 2 observed: "If you give the students instructions, it would be very helpful." Similarly, Participant 5 questioned: "I do not understand what the goal of such an exercise is. We need instructions for this."

Participants also stressed the importance of tailoring instructions to specific activity types, such as pair matching or word searches. Participant 4 underlined that "instructions on completing 'pair matching' exercises are essential for student understanding." Participant 1 echoed this concern, stating: "The problem is that I do not understand what the goal of such

an exercise is.” These comments reinforced the demand for precise and purposeful directions to support students’ comprehension and effective engagement with activities.

6.3.2.1.3.3 Interface and Navigation Instructions

Participants noted that the interface and navigation of the e-book units required clear instructions to improve usability and accessibility, and they highlighted the need for an introductory guide or video to help students use the e-book’s features effectively. Participant 5 shared: “From the beginning, show them how to navigate throughout the book.”

Participant 3 noted: “It took me some time to realise that I needed to click on the specific button to start. It wasn’t clear due to the lack of guidelines or directions, so I started by clicking, but then I realised nothing was working.” Participants also recommended a handbook for teachers providing clear guidelines on using activities and their objectives. Participant 2 shared: “Do you think it is OK to add a handbook for teachers on how to use it? And the objective of each activity.”

6.3.2.2 Theme 3: Technology Problems

Teachers faced several technological challenges when using the Alif Ba’a e-book in their classes. They encountered problems with the e-book interface, as shown in Figure 28, including accessibility issues and language and speed-related problems. Additionally, they had difficulties using the e-book’s features, especially the interactive activities. Inconsistent performance on different devices was a significant concern, and participants also mentioned technical glitches and challenges in integrating the e-book with existing learning management systems.

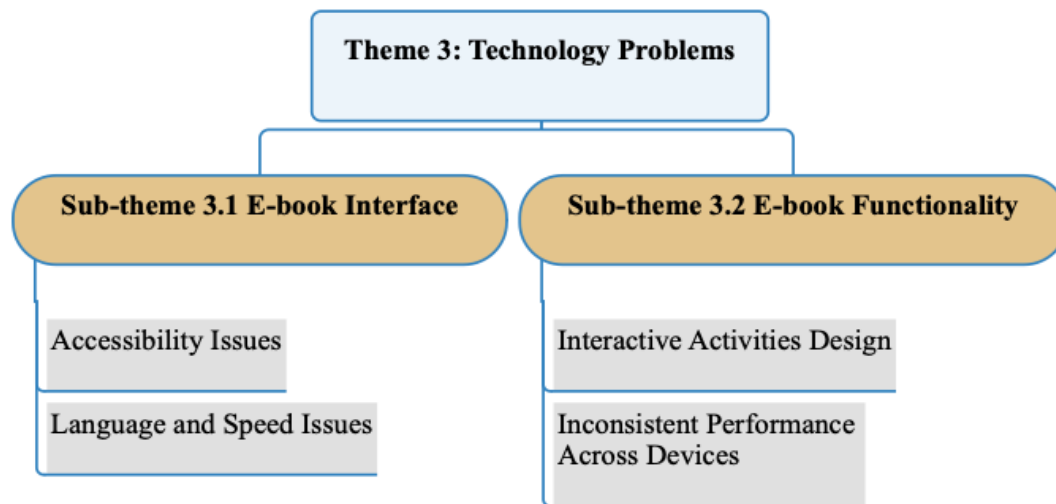


Figure 28: Theme 3-Technology Problems

6.3.2.2.1 Sub-theme 3.1 E-book Interface

6.3.2.2.1.1 Accessibility Issues

Participants appreciated the simplicity and accessibility of the e-book interface but suggested improvements. Participant 2 noted: “It’s very accessible. It’s easy to use. I liked its simplicity; everything is there.” However, participants initially faced difficulties accessing the e-book. Participant 1 remarked, “Only one person was able to access it. The others could not, and the next time we worked on it, almost everybody could access it except one or two.” Another participant added that some students struggled to interact with the e-book, as their inputs were not recognised: “Some students were not, and some couldn’t. They can see it, but they can’t click on it. They try to click, but it’s not capturing their answers.”

6.3.2.2.1.2 Language and Speed Issues

Participant 2 emphasised the need for clearer, more detailed instructions in the interface language, as their absence created confusion. He explained: “The interface language is English, which I’m familiar with, but it lacks detailed instructions. As a student, the absence of guidance makes it unclear what I need to focus on while listening.” Similarly, Participant

4 highlighted problems with the GIF activity, particularly the rapid disappearance of writing demonstrations, which hindered student comprehension: “When I was showing them how to write a letter or a word, it was so fast. I mean to concentrate on something while it disappears quickly.”

6.3.2.2.2 Sub-theme 3.2 E-book Functionality

6.3.2.2.2.1 Interactive Activities Design

One participant highlighted that the design of interactive exercises was more suited to English speakers than Arabic learners, creating challenges for Arabic acquisition. For example, he noted: “Some interactive activities, like Hangman, may not be familiar to everyone.” He further critiqued activities using English conventions, stating: “Crossword puzzles are solved from left to right in English, not right to left like in Arabic. If a student starts writing a phrase like ‘I love’ with the letter B instead of A, it creates confusion.”

Participant 3 also questioned the practicality of certain features, such as the photo-taking option, noting, “Choosing the right picture will take me a while. I don’t find it practical at all; I don’t see any point in having it at all.”

6.3.2.2.2.2 Inconsistent Performance Across Devices

Participants highlighted device compatibility issues, noting failures in tasks such as word highlighting in the word search activity. Participant 4 explained: “Some students had laptops, some had tablets, and some had their phones. Those using phones could highlight words.” Participant 2 described inconsistent performance on Android devices, which hindered exercise completion: “The one person with an Android phone could not do the exercises, but another person with an Android phone could. I don’t know. What’s going on?” Similarly, Participant 3 reported problems with the pair-matching activity, which sometimes malfunctioned unpredictably: “Sometimes these don’t work. I don’t know why.”

6.3.2.3 Theme 4: E-book Multimedia Challenges/Problems

Integrating multimedia components in e-books presented several challenges that significantly affected user experience and learning outcomes. This theme explored the various issues users

encountered, particularly in the context of educational e-books. I identified multiple areas of concern, including the lack of essential auditory activities for phonetic skill assessment and the need for improved control over interactive features. Additionally, there was a call for offline access and better integration with educational platforms to enhance accessibility. Visual design and animation concerns highlighted the importance of clear, culturally relevant instructions. This section outlines the key issues raised by participants and suggests improvements to address these challenges.

6.3.2.3.1 Sub-theme 4.1 Absence of Audio Activities

Participants noted that the e-book lacked audio activities, which was a significant drawback in helping students learn to distinguish and produce different letters. This absence negatively impacted the effectiveness of the learning process. Participant 2 emphasised: “The sound is mostly absent during the learning stage [Present section] and the activities stage [Practice section]. However, it is crucial at this level as it assesses the student’s ability to distinguish letters.” Participant 4 proposed enhancing the sound features by adding play buttons and highlighting letters. He said, “You need an audio file that they can play. It should not play automatically. Instead, it needs a play button so they can play it whenever they feel like it.”

6.3.2.3.2 Sub-theme 4.2 Offline Access

One participant highlighted the significance of providing offline access for users with unreliable Internet connections. Participant 1 noted: “You might not have good Internet access, so being offline would be great, not like the people living in America or Europe.” Additionally, Participant 5 recommended integrating the e-book with platforms like Canvas to facilitate access and usage for teachers and students.

Participant 5 shared: “It should be suitable for autonomous learners. Can we integrate the e-book into Canvas for one-click access without needing to type a separate link?”

6.3.2.3.3 Sub-theme 4.3 Multimedia Integration

Participant 3 noted that the then current use of colours and multimedia was adequate. He shared: “I didn’t have a problem with the colours, but maybe the e-book’s cover could have

a different colour. If you could add more multimedia, that would be nicer.” Participant 5 identified challenges related to the multimedia content within the e-book. She said, “This needs to be more controllable. There was a big challenge in the beginning.” However, the opinions of AFL teachers varied regarding the language activities that required review before enhancing the e-book and its presentation to teachers.

6.4 Teachers and Cognitive Sub-Elements

According to Passey’s cognitive learning elements (2011), participants were instructed to reflect on the motor stimuli associated with cognitive sub-elements integrated into interactive activities, including writing and movement. The analysis revealed two primary themes: “Writing as a Cognitive Sub-Element”, which highlighted writing activities that facilitated language mastery, improved writing pace, and served as effective motor stimuli, and, moreover, “Moving and Interactivity in Learning”, focused on movement and interactive tasks that engaged students through participation.

6.4.1 Theme 1: Writing as a Cognitive Sub-Element

This theme explored how writing activities supported students in mastering the Arabic alphabet, enhancing their writing speed and quality, and acting as a powerful cognitive stimulus in the learning process. Participant 2 emphasised the utility of writing in accelerating students’ learning of the Arabic alphabet. He stated, “The book helped me to do so since I am not asking them to write a lot of pages.”

In addition, Participant 3 observed significant improvements in her students’ writing pace and quality, attributing this to the effectiveness of the writing activities provided by the Alif Ba’a e-book. She remarked, “The writing was effective and helpful. The style is interesting and clean, which is great for my students. I would say writing number one.”

Participant 3 noted significant improvements in her students’ writing pace and quality, attributing them to the writing activities in the Alif Ba’a e-book. She stated, “The writing was effective and helpful. The style is interesting and clean, which is great for my students.” Her observations indicate that these activities fostered clarity and experimentation in students’ writing, essential for learning Arabic.

Participant 5 reflected that writing activities were particularly impactful for students, allowing them to practice both writing and drawing letters, though drawing was not explicitly required.

6.4.2 Theme 2: Moving and Interactivity as Cognitive Sub-Elements

Incorporating movement-based and interactive tasks was identified as a key cognitive sub-element that enriched the learning experience. Activities involving physical interaction (such as dragging, matching, and rearranging) were reported to enhance student engagement and promote deeper cognitive processing through active participation. Participant 2 emphasised the role of movement in cognitive engagement, noting that tasks like pair matching and rearranging words during quizzes prompted meaningful interaction. He stated: “Pair match or memory game is good, but you can utilise it more. If it’s doable... I think of something that can be rearranged by moving words and putting them in slots during a quiz.” This comment reflected a desire to further expand kinesthetic elements within the e-book to stimulate cognitive activity.

Participant 4 reinforced this view, describing how the memory game required students to engage in problem-solving and fine motor skills using a stylus on iPads: “In the memory game, they have to move, use their minds and fingers, and write using the stylus on the iPads to complete the task.” Participant 5 affirmed the overall impact of such cognitive sub-elements on teaching, noting: “The word match, word search, and the crosswords... were beneficial.” Her response indicates that these interactive tasks engaged students and supported instructional goals by enhancing cognitive engagement.

6.5 Cycle 2: Findings of the Focus Group Discussions with Students

In phase two of the DBR, I conducted four focus group discussions with 17 students representing ten nationalities. Each interview, lasting 50 to 60 minutes, was conducted in English via Zoom, with the e-book displayed on the screen, and all participants engaged voluntarily. This section presents the findings from these discussions with AFL students, focusing on two primary RQs:

RQ 5: What are AFL students’ perceptions of using the AFL interactive e-book to learn the

Arabic writing system?

RQ 6: What are the student challenges related to the AFL interactive mobile e-book's PEOU and PU?

6.5.1 RQ 5: Students' Perceptions

When examining RQ 5, which explored AFL students' views on using the AFL interactive e-book for learning the Arabic writing system, the analysis of the discussions revealed two main themes: 1) General Perceptions, and 2) Students' Perceptions of the User's BI. Additionally, sub-themes under the User's BI were classified as the PU and PEOU, as shown in Table 20.

RQ 5: What are AFL students' perceptions of using the AFL interactive e-book to learn the Arabic writing system?	
Themes	Sub-themes
Theme 1: General Perceptions	Sub-theme 1.1: Usage of mobile device Sub-theme 1.2: Quizzes
Theme 2: Students' Perceptions of User's Behaviour Intention (BI)	Sub-theme 2.1: Usefulness Sub-theme 2.2: Ease of Use

Table 20: Themes and Sub-themes for Research Question 5

6.5.1.1 Theme 1: General Perceptions

Several students shared their positive impressions of the Alif Ba'a e-book, highlighting its helpfulness and innovative use of multimedia. Participant 6 praised the e-book for its effective multimedia integration to enhance the learning process; she stated, "I found the e-book very helpful because it uses different kinds of media to get the content across to the learner. I liked the videos that show the movement of the mouth to form a sound." Participant 7's feedback was noteworthy. He viewed the e-book as a valuable tool and supported using technology for learning. He remarked, "The e-book supports struggling students with the Alif Ba'a book, but it is not a standalone teaching method. It complements the original book without replacing it." Participant 14 provided feedback on the e-book, emphasising its multiple platform support. She stated, "The e-book's multiple platform support is great. It will be beneficial as it makes the content easily accessible to everyone." Participant 10's feedback on specific features, such as highlighting and note-taking, showed her willingness

to continue using the e-book. She said: “The e-book is very user-friendly, especially the highlight and notes features, which I found easy to use.” Participant 1 shared remarks about mobile usability and PDF conversion features, demonstrating her favourable attitude towards these technological conveniences. She noted: “I particularly like that it is easy to use on the phone and has a feature where you can convert a page to a PDF and then easily access it later.”

Additionally, students found the quizzes within the e-book helpful for revision. Participant 2 mentioned: “I have only used the e-book for the quizzes at the very end... for like a revision of the entire chapter.” This emphasised the quizzes’ role in reinforcing learning and aiding in the review of chapter content.

6.5.1.2 Theme 2: Students’ Behaviour Intentions

As defined by Tsai (2012), BI refers to an individual’s tendency to utilise technologies in the future (Tsai, 2012). When viewed from a student’s standpoint, the TAM elucidates the students’ intention to use the e-book by focusing on two primary measures: the PEOU and PU of the technology (Davis et al., 1989).

6.5.1.2.1 Sub-theme 2.1: Usefulness

Students were particularly enthusiastic about the Alif Ba’a e-book’s PU in AFL. As shown in Figure 29, they found the e-book to be a powerful tool for enhancing their learning, improving content accessibility, incorporating interactive features and multimedia content, providing practice activities, facilitating independent learning, and integrating games.

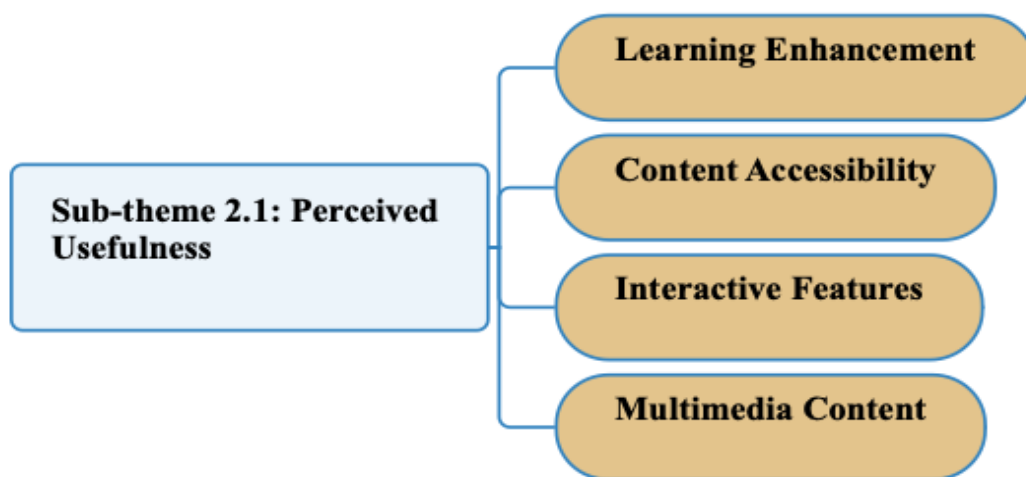


Figure 29: Sub-theme 2.1 Perceived Usefulness

6.5.1.2.1.1 Learning Enhancement

The AFL interactive e-book significantly enhanced learning by offering various tools that aided in understanding and practising the Arabic writing system. Participant 17 appreciated the e-book’s particularly useful pronunciation guides: “I thought it was helpful to see how to say the letter, like how to pronounce it.” Participant 2 highlighted the effectiveness of the quizzes at the end of each chapter, which emphasised the quizzes’ role in reinforcing learning and aiding in the review of chapter content. Participant 8 found the e-book especially beneficial for beginners: “The e-book is very convenient to use for beginners. It has all the options on how to write the letters... it contains the audio on how to pronounce it.”

6.5.1.2.1.2 Content Accessibility

The accessibility of the e-book was a critical aspect of its PU. Participant 14 emphasised that the e-book’s availability across multiple devices and its support for various languages made it highly user-friendly: “It was quite easy to access it.” This feature allowed students to access learning materials anytime, supporting continuous learning.

Participant 13 appreciated the e-book’s structured approach to language acquisition, covering everything from basics to practical application. He stated, “It is great that this e-book starts from the beginning. It introduces a letter and then goes on to the speaking part, writing part,

and then the listening part, and then practice.” Other student participants also mentioned that: “I found it very accessible.” (P12) and “The layout was user-friendly, allowing easy navigation through all features.” (P10)

6.5.1.2.1.3 Interactive Features

The interactive elements incorporated into the e-book, including games, quizzes, and instant feedback, enhanced the learning experience. Participant 3 was fond of the gaming features: “I also enjoyed the quizzes and other games. I like the gaming aspect of it, especially the crossword and, at the beginning, the videos about writing different characters.”

Students appreciated instant feedback on quizzes, as it helped them promptly assess their performance and identify areas for improvement, making learning more dynamic. Participant 14 highlighted the benefit of immediate results, stating: “Having the option to submit provides instant feedback, which is particularly helpful for independent study” Furthermore, Participant 13 found the practice activities beneficial for reinforcing new knowledge: “It was useful because once you learn something new, the most important thing that you can do is practice it somewhere, and this exercise, this e-book we mainly used for practice, so it is beneficial.”

6.5.1.2.1.4 Multimedia Content

Student participants praised the e-book’s multimedia content for its impactful features, such as animations, videos, and interactive exercises, which were noted to enhance understanding and engagement. Participant 6 mentioned that the e-book was helpful, effectively utilising various media and videos to demonstrate mouth movements for letter formation. Multimedia played a valuable role in enhancing students’ understanding of Arabic phonetics. Students found animations helpful for letter formation and appreciated the instructional videos on sound production. Participant 15 noted, “I liked the different videos you showed of how to produce sounds and what it sounds like when hearing it.”

In discussions about the visual design and colour scheme, participants stressed the significance of colour coordination and the aesthetic appeal of the e-book. Participant 12 expressed: “I liked how the colours were organised in the book... everything was clear and

like we could read what was needed.”

The incorporation of audio-visual aids to assist with pronunciation and writing was well-received by the participants. Participant 16 observed: “It is very helpful to have the audio and the visual because you can see what it looks like as well as hear.” Participant 7 also expressed: “You can control the speed of the words... that is not so much of a desired feature, but when you have words or a sentence, then being able to slow that down would be very helpful.”

6.5.1.2.2 Sub-theme 2.2: Perceived Ease of Use

Regarding the PEOU of the Alif Ba’a e-book, students reported that they found it user-friendly on their mobile devices and that the ease of navigation and features of the e-book were appealing, as shown in Figure 30.

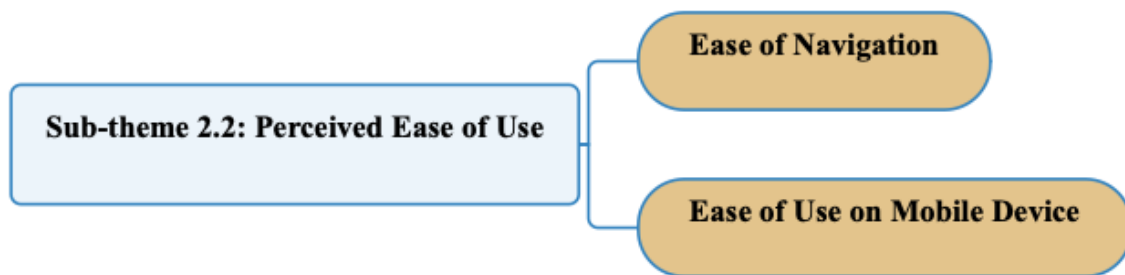


Figure 30: Sub-theme 2.2: Perceived Ease of Use

6.5.1.2.2.1 Ease of Navigation

One of the key sub-themes was ease of navigation. Students appreciated the straightforward navigation and simplicity of the interface. Participant 14 remarked: “It is easy, easy navigation, easy to understand, not very complicated.” Participant 15 also emphasised the importance of a consistent layout: “The fact that every single page had the same layout and format... Made it very easy to follow.” The uniformity in page layout aided in following along and understanding the content seamlessly.

The navigation and additional features, such as highlighting and note-taking, were appreciated for aiding in revision. Participant 6 mentioned: “I like the usefulness of all these tools for revision purposes... you can highlight and take notes, so you can remember anything

you are unsure about and come back to it later on.” This underscored the utility of these features in supporting effective learning and revision.

6.5.1.2.2.2 Ease of Use on Mobile Devices

The e-book’s ease of use on mobile devices was frequently mentioned. Participant 1 shared positive remarks about mobile usability and PDF conversion features, demonstrating her favourable attitude towards these technological conveniences. She noted: “I like that it is easy to use on the phone.” This emphasised the importance of mobile compatibility for enhancing accessibility and convenience.

6.5.2 RQ 6: Challenges for AFL students

Research question 6 focused on identifying the student challenges associated with the PEOU and PU of the AFL interactive e-book. To address this RQ, I conducted a TA of the qualitative data collected from 5 student interviews in focus group discussions. These themes were: Pedagogical Problems, Technology Problems, and E-book Multimedia Problems. Each had sub-themes that were identified from the data collected from 17 AFL students. Table 21 presents a summary of the analysis, identifying the overarching themes and their respective sub-themes.

QR 6: What are the student challenges related to the AFL interactive mobile e-book's ease of use and perceived usefulness?	
Themes	Sub-themes
Theme 3: Pedagogical Problems	Sub-theme 3.1: Activity Instructions
Theme 4: Technology Problems	Sub-theme 4.1: E-book Interface Sub-theme 4.2: E-book Functionality
Theme 5: E-book Multimedia Problems	Sub-theme 5.1: Audio-Visuals Integration Sub-theme 5.2: Colour and Font Selections

Table 21: Themes and Sub-themes for Research Question 6

Participants shared insights on the e-book’s pedagogical, technological, and multimedia aspects, offering valuable recommendations to improve its functionality, design, and user experience.

6.5.2.1 Theme 3: Pedagogical Problems

6.5.2.1.1 Sub-theme 3.1: Activity Instructions

Several students suggested that the activity instructions could have been clearer and more specific. Nevertheless, some students found the instructions to be precise. Participant 16 remarked: “The instructions clearly outline what to do with the exercise. The interactive pair match is self-explanatory based on its name.” Some students, like Participant 8, noted that clearer instructions for activities would have helped them understand how to proceed. Participant 8 suggested: “Maybe add a couple of instructions on the letter pages.” Participant 15 shared: “I had trouble with the connect letters because I thought I was supposed to move the letters around on the computer to form a word, but it never worked.” The misunderstanding frustrated the students and hindered their task completion, leading to disengagement. However, an earlier understanding of the instructions could have improved the activity. Participant 15 shared: “Now I know what I am supposed to be doing, that could be very helpful.” Participant 8 also raised concerns about the crossword puzzle instructions: “Regarding the crossword, it was not clear that we had to write the letters.” These examples highlighted the need for clearer instructions to help students with the activities. Participant 8 recommended adding brief instructions for activities that involved writing letters, making the tasks clearer and more accessible to learners. She mentioned: “Clearer instructions are needed, such as writing the words and letters letter by letter.”

6.5.2.2 Theme 4: Technology Problems

6.5.2.2.1 Sub-theme 4.1: Poor Interface Design

Students initially found the e-book interface confusing, though usability improved with familiarity. Others, such as Participant 12, expressed confusion about the distinction between the “practice” and “produce” sections, recommending alternative wordings to enhance clarity and ease of navigation for first-time users. To address initial confusion, Participant 3 recommended adding a tutorial page that guided new users through the key features of the e-book interface.

The e-book’s interface functionality issues significantly hindered Participant 15’s learning,

as she struggled to view full images and reported difficulty scrolling, limiting her access to complete content. This indicated a need for improved content optimisation across various screen sizes and enhanced scroll functionality. Similarly, Participant 13 encountered challenges due to slow loading times, which obstructed her ability to access the e-book effectively, stating it was “too heavy” for her device. Participant 3 highlighted concerns about loading delays, emphasising the need to optimise the e-book's performance for users with lower-specification devices.

6.5.2.2.2 Sub-theme 4.2: E-book Functionality

Several participants reported issues with the e-book on mobile devices. Participant 6 stated: “On the mobile browser, it does not work at all, like it does not open PDF for me at least.” They also noted glitches requiring refreshes, including the e-book getting stuck in writing mode. These problems emphasised the need for full mobile compatibility, as many students used phones to access resources.

Text-input barriers compounded these issues: Participant 13 lacked an Arabic keyboard and used an external site before pasting into the e-book: “I did not have an Arabic keyboard, so I had to practice typing on my laptop and then copy and paste from a website.” Others had hardware limits: Participant 7 said, “It is frustrating if you are on a laptop, especially with the trackpad”, while Participant 2 noted, “It is hard for me to write with a mouse, and I do not have an iPad with a pen.” Feedback indicated a need for improved mobile functionality and support for varied input devices for inclusivity.

6.5.2.3 Theme 5: E-book Multimedia Problems

Students faced challenges with the e-book multimedia, including issues related to integrating video and audio, font choices, colour themes, and the visibility of bookmarks and notes. Additionally, they expressed a need for faster search functionality and encountered technical issues with quizzes and games. The upcoming sections contain quotes that highlight the different challenges students encountered when using the Alif Ba’a e-book.

6.5.2.3.1 Sub-theme 5.1: Audio-Visual Integration

Participant 12 expressed dissatisfaction with the anatomical videos demonstrating pronunciation. She said, “I found the video in the e-book ineffective for learning pronunciation and preferred the method on another website, where real people demonstrated how to pronounce sounds.” This pointed out a challenge in visually representing pronunciation within the e-book. The participant suggested that real-life demonstrations, like those on other websites, effectively showed how to articulate sounds by visually illustrating mouth movements.

Participant 15 faced challenges with audio clarity during the study, which significantly hindered engagement in pronunciation exercises: “I have struggled with pronunciation, especially with how the different sounds work together.” Although no explicit solution was proposed, the reported struggle underscored the need for enhanced sound quality in e-books to facilitate more effective pronunciation learning.

6.5.2.3.2 Sub-theme 5.2: Colour and Font Selections

Through analysis, I identified issues with the e-book’s colour scheme, noting a lack of cohesion. Participant 10 remarked: “The interface needs a little more harmony, especially with the ongoing theme with the whole e-book.” Participant 9 echoed this, criticising the main colours: “There is no colour harmony—purple and green... They do not go together, and I do not like the font used.” Participant 14 added that the colours were too muted. Participant 12 noted confusion from a mismatch with the textbook: “I noticed that the colour scheme did not match the book. I thought it was related to the textbook only because of the name, not because of the colour scheme.” These points underscored the need for a unified visual identity.

Font-related issues hindered usability. Participant 8 described the dropdown menu font as problematic: “The most challenging part is the font of the menu dropdown.” Participant 9 also found the font unattractive and lacking harmony with the colour scheme.

Several participants suggested increasing the font size for better readability, particularly in the dropdown menu. They also recommended enhancing colour harmony, increasing

vibrancy, and improving font aesthetics to create a more engaging and professional interface.

6.6 Students and Cognitive Sub-Elements

According to Passey's cognitive elements (2011), participants were prompted to consider the motor stimuli concerned with the following cognitive sub-elements that were included in various interactive activities in the e-book: writing, reporting, speaking, presenting, drawing, completing, and moving. The participants' responses revealed two primary themes. The first theme, "Motor Skills and Cognitive Engagement", encompassed the sub-themes "Writing and Speaking" and "Movement and Memory Games." The second theme, "Interactive Cognitive Tools and Fun in Learning", included the sub-theme "Cognitive Stimulation Through Interactive Games."

6.6.1.1 Theme 6: Motor Skills and Cognitive Engagement

A primary theme identified from the data analysis, highlighting the significance of motor skills such as writing, speaking, movement, and task completion (e.g., memory games) in stimulating cognitive sub-elements during the learning process. Participants frequently cited hands-on activities like crosswords, drawing, and movement-based games as pivotal factors in their cognitive development.

6.6.2 Sub-theme 6.1: Writing and Speaking

Participant 13 mentioned: "For me, it was definitely listening and speaking and writing." She highlighted that these cognitive sub-elements were central to her learning experience, as they facilitated more profound engagement with the material through active participation in language use, such as writing and verbal communication.

Participant 6 emphasised the significance of writing and speaking as fundamental cognitive sub-elements, elucidating how the process of formulating sounds implied a correlation between phonetic comprehension and motor functions in language acquisition. She said: "Writing as well, cause it's pretty comprehensive on how to write and also, speaking, like how to formulate the sounds of each letter."

6.6.2.1 Sub-theme 6.2: Moving and Memory Games

Participant 14's participation in movement-based activities, such as crosswords and word matching, demonstrated how physical interaction positively impacted cognitive functions like memory and task completion. As a novice, she enjoyed these games for their interactive and problem-solving aspects, which enriched her learning experience by making it more enjoyable. Participant 14 shared: "We played games like crossword, finding, or matching words. That was the fun part because when you know words and then you find them as a beginner, it is an exciting thing."

Participant 12 emphasised the connection between physical movement and cognitive engagement by focusing on memory games and task completion. She underscored that engaging in movement-based activities, such as memory games, enhanced her learning by stimulating cognitive engagement and improving memory retention. Participant 12 mentioned: "The fact that it is completing and moving... like the memory game, if you need to click here, you move around."

Participant 11 reflected on the positive impact of writing as a motor stimulus and activities like word searches on his learning. He highlighted the benefits of completing word searches and connecting words, noting that writing exercises, especially done on paper at home, were crucial for providing essential motor stimulation.

6.6.3 Theme 7: Cognitive Stimulation Through Interactive Games

Participants' experiences illustrated how interactive tools such as games effectively engaged cognitive sub-elements associated with problem-solving and task completion. Participant 7 reflected on how games, particularly those involving crosswords and memory challenges, had contributed to reinforcing his learning. He mentioned: "Games like those are completing... I do not know exactly what moving means but completing... those were the features I use the most often on Alif Ba'a e-book." Moreover, Participant 14 found movement-based games enjoyable. She perceived the cognitive stimulus of "moving" as an effective way to reinforce learning through engaging activities. She noted, "This is fun. We already knew the script, but for those who did not know the script, it is very exciting to play

such games.”

Participant 16 emphasised that incorporating individual letters into words represented a practical manifestation of cognitive sub-components involving task completion and idea linkage. This process ultimately aided in the retention and understanding of information. He explained: “The first few exercises involved looking at letters, but it was helpful when they incorporated words using the specific letters we were learning. It’s easier to memorise the letters when they are part of a specific word.” Participant 3 found a correlation between writing and drawing. He mentioned, “I consider it both. Like memory games... The writing, like the drawing, seems right. But of course, it is also about drawing.”

Finally, Participant 15 stressed the importance of repetition and motor stimulus in learning pronunciation, reflecting how cognitive elements such as listening and speaking repeatedly helped reinforce her learning process. She highlighted, “I liked the videos you showed of how to produce this sound and what it sounds like when you hear it. So, then I can practice that again.”

6.7 Cycle 3: Findings of the Quantitative Online Survey

This quantitative section used online questionnaires to evaluate AFL teachers’ and students’ acceptance and perceptions of the refined Alif Ba’a e-book. The surveys assessed the e-book’s effectiveness in terms of PU, PEOU, convenience, compatibility, media richness, and interactivity. Conducted via Qualtrics software for secure response collection, the results were analysed using IBM SPSS version 26 with frequency analysis. The student questionnaire included 49 items, while the teacher version had 46, both focusing on the e-book’s features and effectiveness.

6.7.1 Student Data Analysis Results

This section provides detailed student response patterns, as this was an early stage of a novel Arabic alphabet e-book. Item-level detail helps identify which features work well and which might be further developed. To aid interpretation with a modest sample and an ordinal five-point Likert scale in which the neutral midpoint was deliberately replaced with “I do not know”, this section reports a “top-two-box” agreement metric by combining “Strongly agree”

and “Somewhat agree.” Collapsing these adjacent, positive categories is methodologically defensible because it preserves the directional meaning of responses without implying interval-level precision, reduces sparsity in cell counts, and yields a clearer summary of positive endorsement aligned with the study’s descriptive aims. For transparency, disaggregated percentages for each response option (including “I do not know” and missing data) are also presented in the figures/tables, and combined totals are shown alongside their component values. Regarding dissatisfaction, the questionnaires were anonymous and analysed at the item level, so it is not possible to determine whether the same individuals consistently expressed disagreement across features; small disagreement proportions are therefore reported without attribution to particular respondents or subgroups. This caveat alerts readers to the possibility of either consistent or item-specific dissatisfaction.

6.7.1.1 Perceived Usefulness of the Alif Ba’a E-book

Section One of the student questionnaire assessed the Alif Ba’a e-book’s effectiveness by evaluating participants’ agreement on using it for Arabic writing, pronunciation, reading, and mastering the alphabet, as shown in Figure 31. It also considered the value of audio content, the e-book’s motivational impact, and the feedback received. Overall, responses were positive, particularly regarding writing and audio materials, although motivation and retention of the Arabic alphabet need improvement. The high agreement levels highlighted the e-book’s effectiveness in improving Arabic skills, despite some differences of opinion among participants.

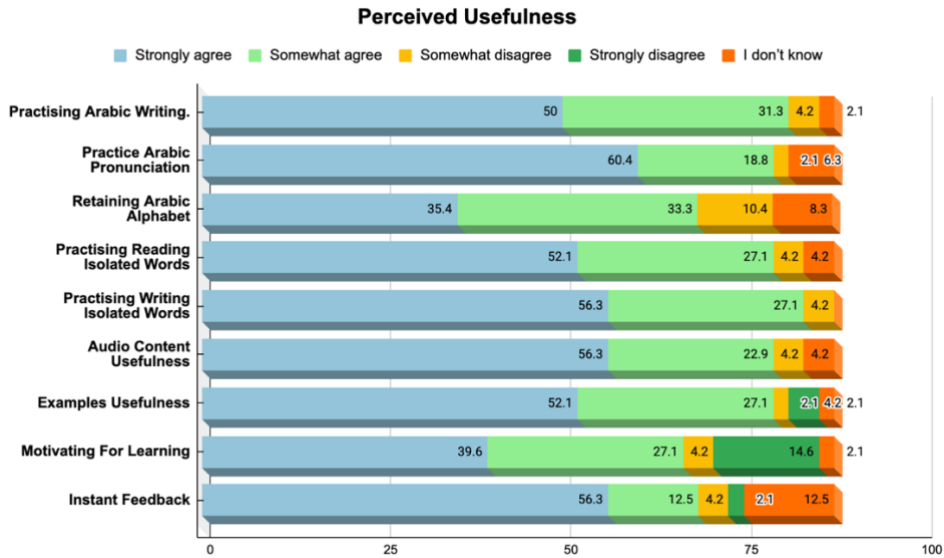


Figure 31: Perceived Usefulness

Figure 32 shows that most respondents found the Alif Ba'a e-book beneficial for practising writing the Arabic alphabet. Specifically, 50% (n=24) of participants strongly agreed, and 31.3% (n=15) somewhat agreed, yielding an **overall agreement** of 81.3% (n=39). Only a minimal fraction expressed disagreement, with 4.2% (n=2) somewhat disagreeing and 2.1% (n=1) selecting “I don’t know”. The remaining 12.5% of data points were missing. The results show strong approval of the Alif Ba'a e-book’s writing features, indicating broad satisfaction with its effectiveness in enhancing writing skills.

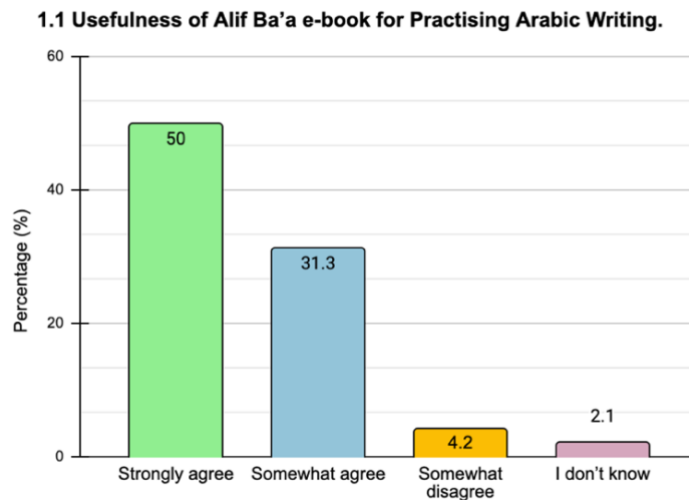


Figure 32: Enhancing Writing Skills

The feedback regarding the effectiveness of the Alif Ba'a e-book in aiding users with pronouncing the Arabic alphabet reveals a strong consensus, as shown in Figure 33. Among the participants, 60.4% (n=29) strongly agreed, while 18.8% (n=9) somewhat agreed. This results in a total agreement rate of 79.2% (n=38). A minor percentage, 2.1% (n=1), somewhat disagreed, and 6.3% (n=3) selected "I don't know". Additionally, missing data constituted 12.5% of the overall responses. The cumulative percentages show a positive trend, indicating widespread satisfaction with the e-book's impact on pronunciation skills.

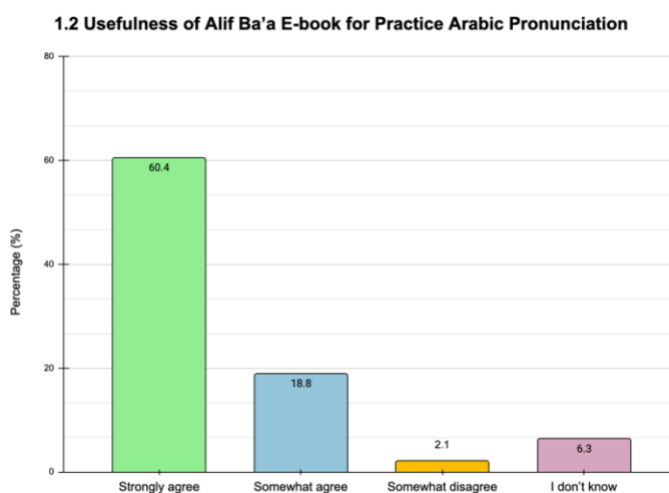


Figure 33: Improving Pronunciation Skills

Compared to other learning methods, the responses regarding the effectiveness of the Alif Ba'a e-book in assisting users with retaining the Arabic alphabet demonstrate a generally favourable response, as shown in Figure 34. Among the participants, 35.4% (n=17) expressed strong agreement, while 33.3% (n=16) somewhat agreed, resulting in a total of 68.7% (n=33) in agreement. In contrast, 10.4% (n=5) somewhat disagreed, and 8.3% (n=4) selected "I don't know". Additionally, missing data accounted for 12.5% of the overall responses. These results show a gradual trend towards agreement, suggesting that while most found the e-book effective, the consensus was not as strong as for other methods.

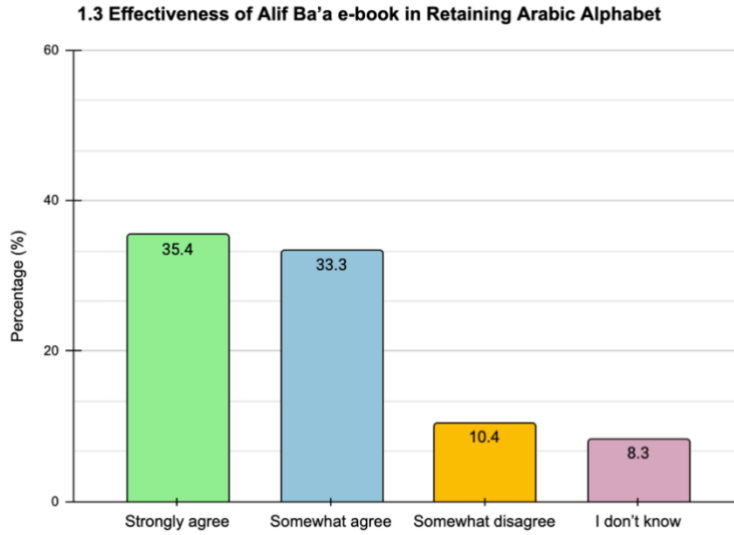


Figure 34: Retention of the Arabic Alphabet

The survey findings, illustrated in Figure 35, reveal that most participants recognised the e-book’s effectiveness in isolated word reading. Specifically, 52.1% (n=25) strongly agreed, while 27.1% (n=13) somewhat agreed, culminating in a total agreement rate of 79.2% (n=38). A small fraction of respondents, 4.2% (n=2), somewhat disagreed, and another 4.2% (n=2) selected “I don’t know”. It is worth noting that 12.5% of responses were missing. These results underscored the e-book’s positive influence on enhancing literacy skills, particularly in isolated word recognition.

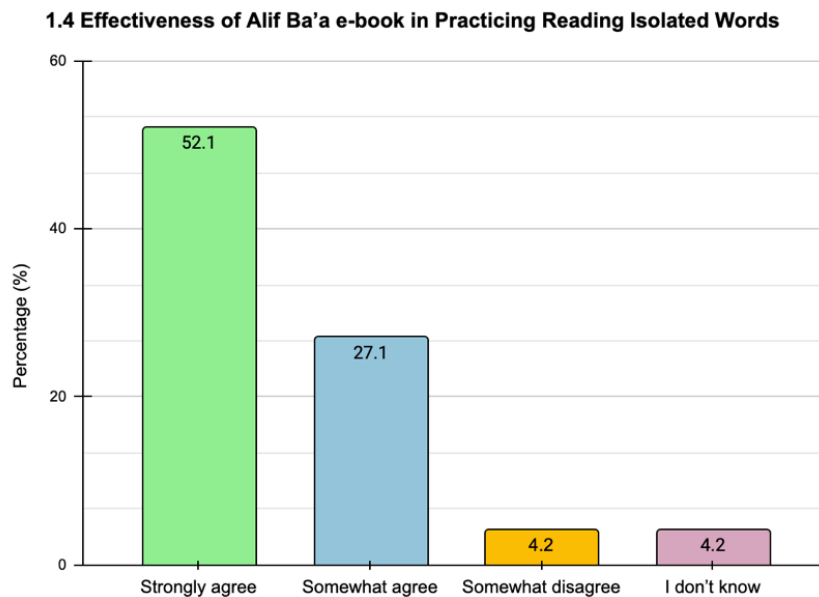


Figure 35: Reading Isolated Words

Figure 36 shows the responses regarding the Alif Ba'a e-book's effectiveness in improving participants' abilities to practice writing isolated Arabic words, showing strong agreement among users. Most participants, 56.3% (n=27), strongly agreed, and 27.1% (n=13) somewhat agreed, resulting in a total agreement of 83.4% (n=40). A small proportion, 4.2% (n=2), somewhat disagreed. Missing responses accounted for 12.5% of the total data.

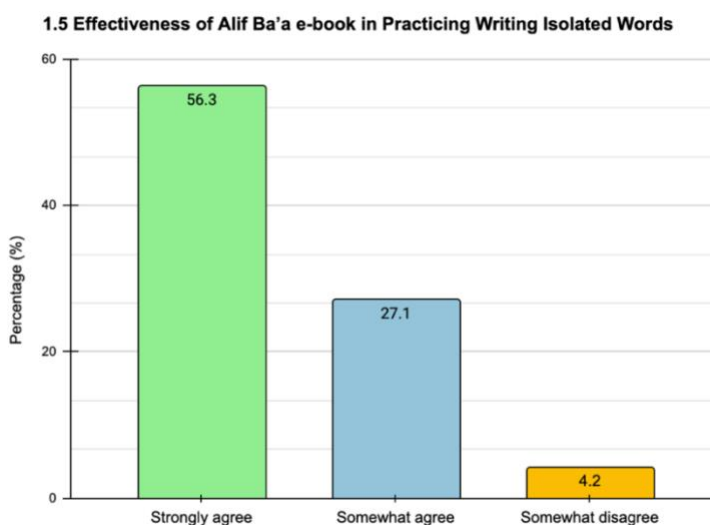


Figure 36: Writing Isolated Words

Compared to the previous question on practising reading isolated words, similar trends are observed, with high agreement in both areas (writing, 83.4%, reading, 79.2%). However, the proportion of strong agreement is slightly higher for writing practice (56.3%) than for reading (52.1%). These figures suggest that participants perceived the e-book as slightly more effective for improving their writing of isolated words in Arabic. Taken together, the slight differences between writing and reading (overall agreement 83.4% versus 79.2%; strong agreement 56.3% versus 52.1%) indicate a balanced perceived benefit across both skills.

The feedback regarding the audio content of the Alif Ba'a e-book highlighted, as shown in Figure 37, a strong level of user satisfaction with the assistance of practising the Arabic alphabet. A significant majority of participants, 56.3% (n=27), strongly agreed, while an additional 22.9% (n=11) somewhat agreed, resulting in a combined agreement rate of 79.2% (n=38). Conversely, only a tiny percentage of participants, 4.2% (n=2), somewhat disagreed, with the same percentage indicating uncertainty by selecting "I don't know".

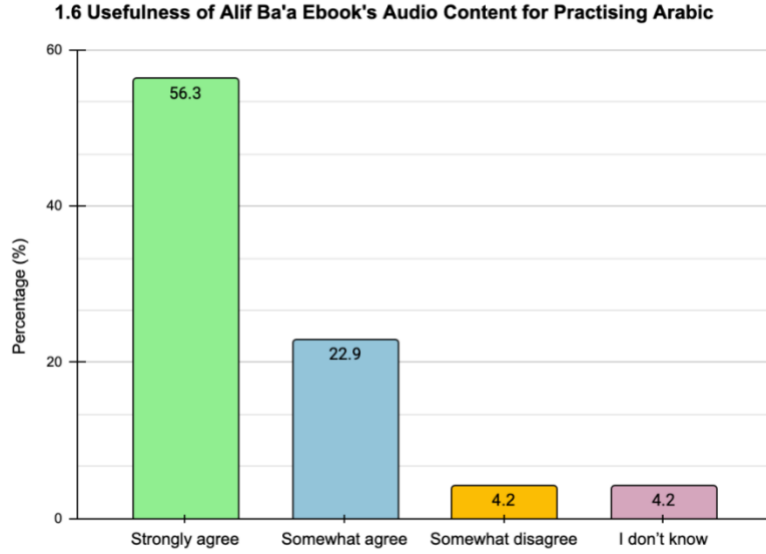


Figure 37: Audio Content for Practising Arabic

The analysis of user feedback on the Alif Ba'a e-book revealed a strong approval rate of 79.2% regarding the provided examples, as shown in Figure 38. While most users found them effective, 4.2% disagreed, and another 4.2% were unsure, highlighting an opportunity to improve or clarify the examples for those less convinced.

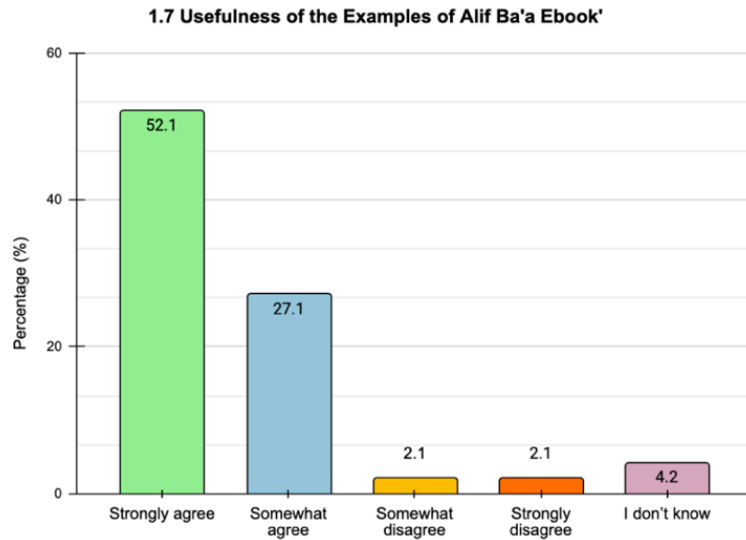


Figure 38: Usefulness of the E-Book Examples

Figure 39 shows the responses regarding the Alif Ba'a e-book's role in motivating participants to practice learning the Arabic alphabet, which reflected a generally positive trend. A significant proportion of participants, 39.6% (n=19), strongly agreed that the e-book motivated them, while an additional 27.1% (n=13) somewhat agreed. These responses indicate that 66.7% of participants found the e-book motivational. However, a smaller subset expressed less favourable views, with 4.2% (n=2) somewhat disagreeing and 2.1% (n=1) strongly disagreeing. Interestingly, 14.6% (n=7) of respondents selected "I don't know", suggesting a degree of uncertainty regarding the e-book's impact on their motivation. I identified that while most participants experienced a positive motivational influence from the e-book, a smaller group disagreed about its effectiveness in this regard.

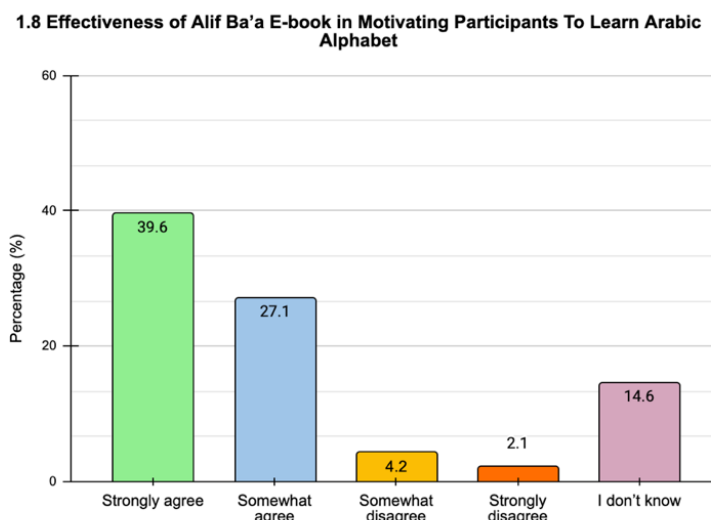


Figure 39: Motivation to Learn

The responses regarding the usefulness of instant feedback in practising reading and writing the Arabic alphabet (see Figure 40) highlighted a predominantly positive reception. Most participants, 56.3% (n=27), strongly agreed that instant feedback was helpful, while 12.5% (n=6) somewhat agreed. These responses indicated that 68.8% of participants found instant feedback beneficial. However, a smaller proportion expressed reservations, with 4.2% (n=2) somewhat disagreeing and 2.1% (n=1) strongly disagreeing. An additional 12.5% (n=6) selected "I don't know", suggesting uncertainty about the feedback's impact. These results suggested that while instant feedback was valued by many participants, only some displayed mixed or uncertain views about its effectiveness.

1.9 Effectiveness of the Feedback of Alif Ba'a E-book in Participants Reading and Writing Arabic Alphabet

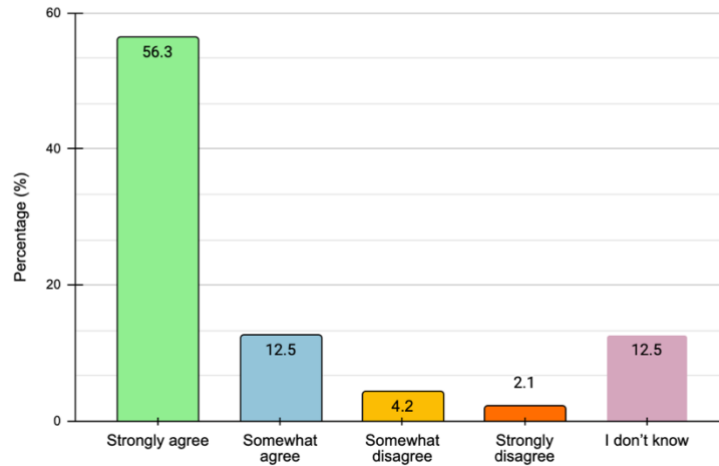


Figure 40: Instant Feedback

The evaluation of the Alif Ba'a e-book's effectiveness in facilitating the practice of the Arabic alphabet revealed a high level of approval among participants. As shown in Figure 41, a significant majority, 59.5% (n=25), agreed strongly with the e-book's usefulness, while 38.1% (n=16) somewhat agreed. This cumulative agreement rate of 97.6% underscored the e-book's considerable effectiveness in supporting learners' acquisition and refinement of Arabic alphabet skills. Only 2.4% (n=1) of participants expressed dissatisfaction, suggesting that perceived ineffectiveness was low. Most participants viewed the e-book as a valuable resource for improving their practice of the Arabic alphabet.

1.10 Overall Usefulness of Alif Ba'a in Practicing Arabic Alphabet

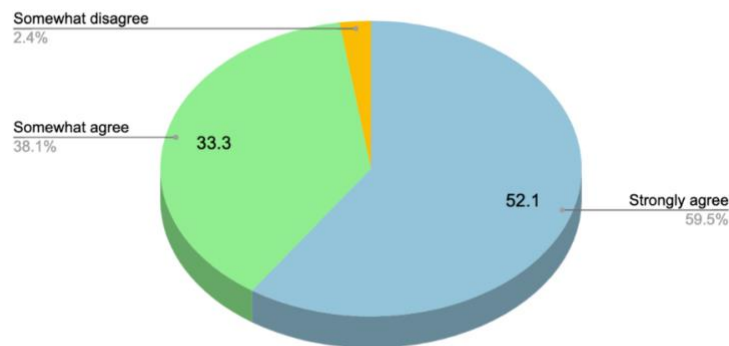


Figure 41: Overall Usefulness of the E-book

6.7.1.2 Perceived Ease of Use

Survey results regarding the PEOU of the Alif Ba’a e-book (Figure 42 show a generally positive reception: respondents praised its visually appealing layout, well-structured design and clear instructions, finding guidance easy to follow. Navigation and user-friendliness were commended for logical flow and an intuitive interface, although opinions on ease of access varied more, with a minority finding it less accessible. Most respondents found completing interactive activities and assignments easy, noting processes were seamless and efficient; submitting assignments was regarded as easy despite a small minority expressing disagreement or uncertainty. The e-book also enhanced users’ confidence in mastering the Arabic alphabet and appeared effective in meeting learning objectives. Although the overall responses were positive, improvements in areas such as ease of access and assignment completion could effectively address the concerns of a smaller subset of users.

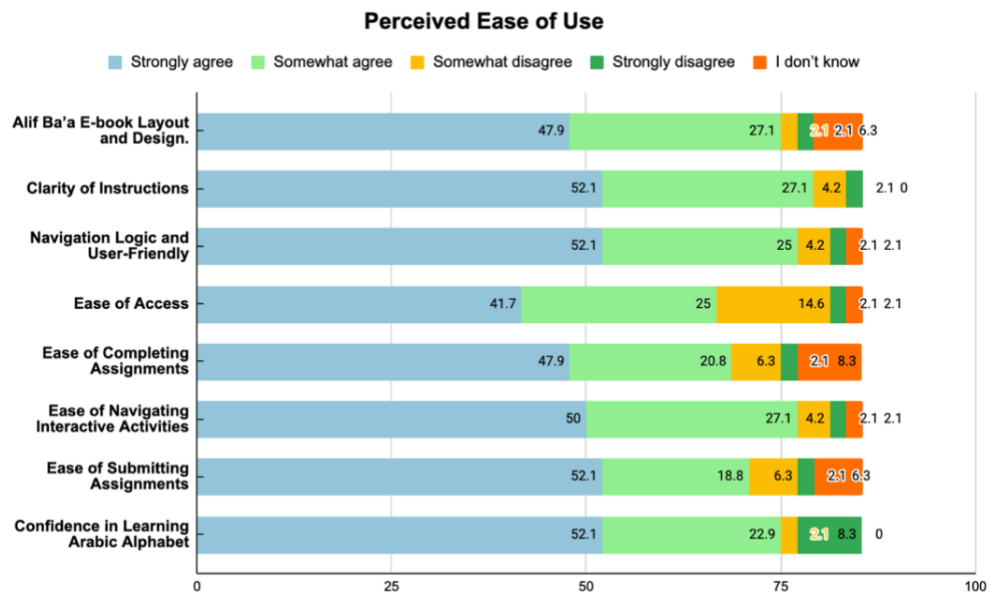


Figure 42: Perceived Ease of Use

The responses regarding the ease of use of the Alif Ba’a e-book, attributed to its layout and design, demonstrated strong agreement. Figure 43 shows that nearly half of the participants, 47.9% (n=23), strongly agreed that the e-book was easy to use due to its layout and design, while 27.1% (n=13) somewhat agreed. Together, this represents a 75% agreement rate. A small percentage, 2.1% (n=1), somewhat disagreed, and an equal percentage strongly

disagreed, reflecting minimal dissatisfaction. Additionally, 6.3% (n=3) selected “I don’t know”, indicating uncertainty. These results highlight that the layout and design of the e-book played a key role in its perceived usability for most participants.

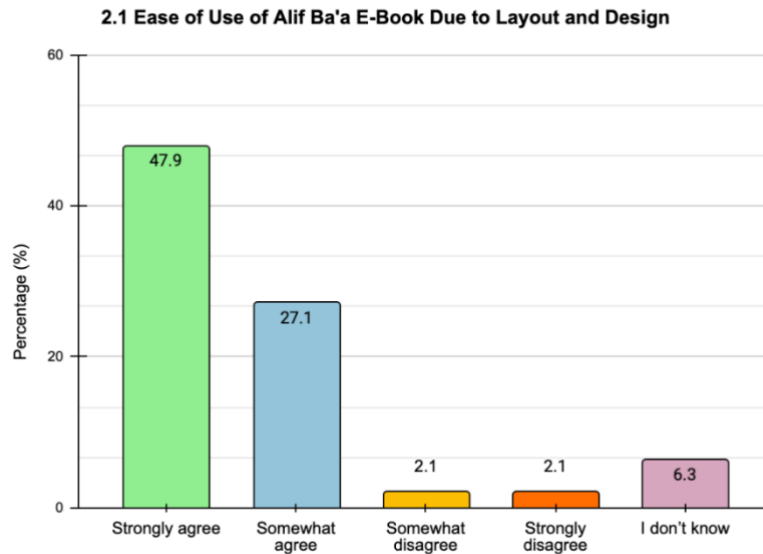


Figure 43: the E-book Layout and Design

The responses regarding the clarity and ease of following instructions in the Alif Ba’a e-book reflected strong agreement. Figure 44 shows that most participants, 52.1% (n=25), strongly agreed that the instructions were clear and easy to follow, while 27.1% (n=13) somewhat agreed. Combined, this indicates a 79.2% agreement level among participants. A smaller percentage, 4.2% (n=2), somewhat disagreed, and 2.1% (n=1) strongly disagreed, reflecting minimal dissatisfaction. These findings suggested that the e-book’s instructions were well-received by most users, contributing positively to their learning experience.

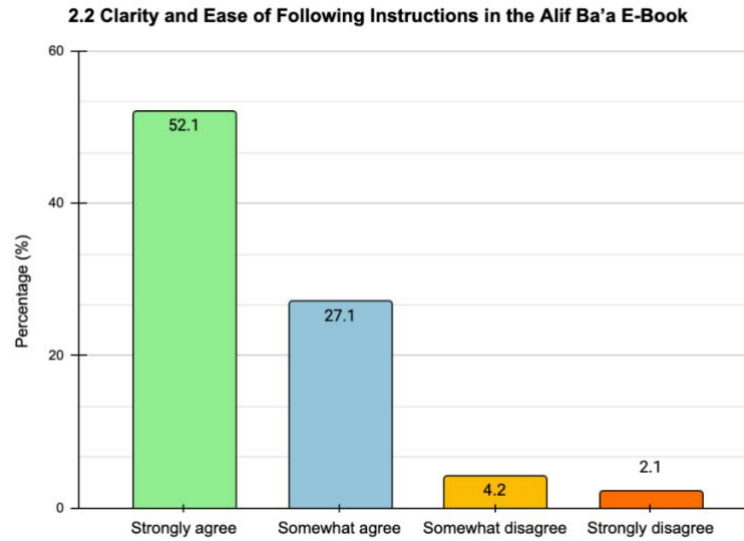


Figure 44: Clarity and Ease of Following Instructions in the E-book

The responses regarding the logical and user-friendly navigation of the Alif Ba'a e-book (see Figure 45) reflected a strong positive reception. Most participants, 52.1% (n=25), strongly agreed, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement level of 77.1%. A smaller portion, 4.2% (n=2), somewhat disagreed, while 2.1% (n=1) strongly disagreed, and an equal percentage selected "I don't know", indicating minimal dissatisfaction or uncertainty. These findings suggested that most users found the e-book's navigation system intuitive and user-friendly.

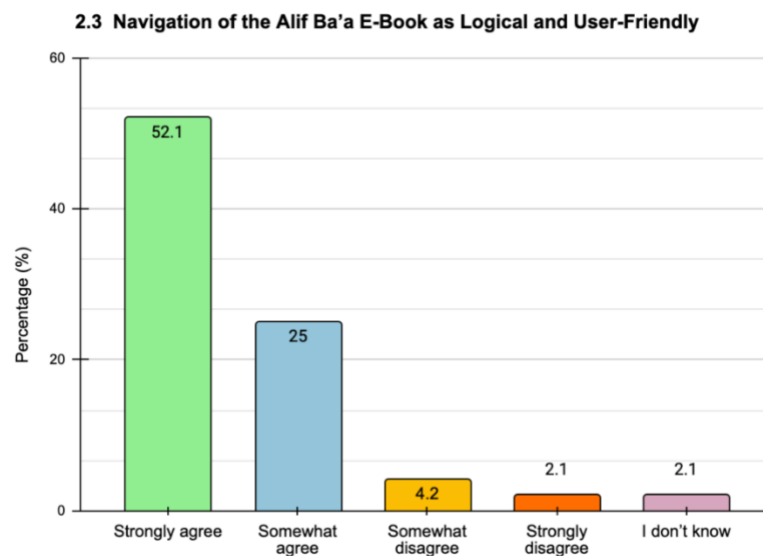


Figure 45: Navigation of the E-Book

The responses regarding the ease of accessing the Alif Ba'a e-book on a device reflected a moderately positive perception. As shown in Figure 46, among participants, 41.7% (n=20) strongly agreed that accessing the e-book was easy, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement level of 66.7%. A noticeable portion, 14.6% (n=7), somewhat disagreed, and smaller percentages, 2.1% (n=1), strongly disagreed or selected "I don't know". Most users found accessing the e-book convenient, but some faced challenges with device compatibility and usability.

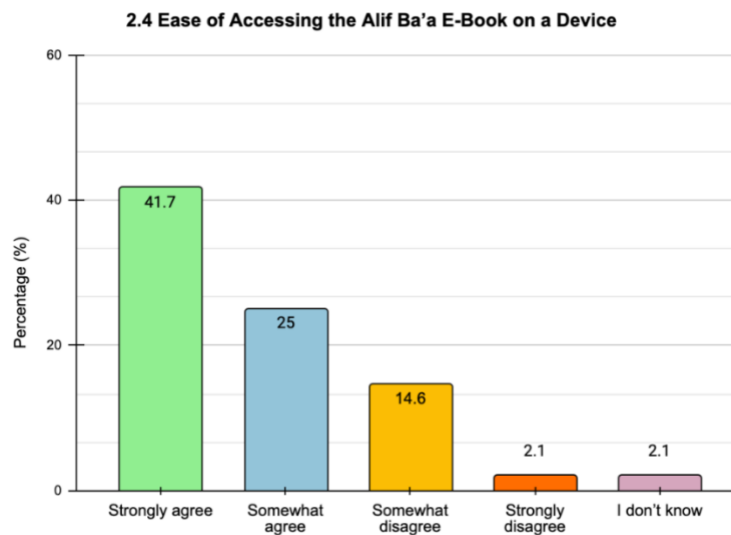


Figure 46: Ease of Accessing the E-Book

As shown in Figure 47, the responses regarding the ease of completing assignments on the Alif Ba'a e-book indicated a generally positive perception. Nearly half of the participants, 47.9% (n=23), strongly agreed, while 20.8% (n=10) somewhat agreed, culminating in a combined agreement of 68.7%. A smaller portion, 6.3% (n=3), somewhat disagreed, and 2.1% (n=1) strongly disagreed. Additionally, 8.3% (n=4) selected "I don't know", indicating some uncertainty. These findings suggest that while the majority found completing assignments on the e-book straightforward, there remained a notable minority with mixed or uncertain experiences.

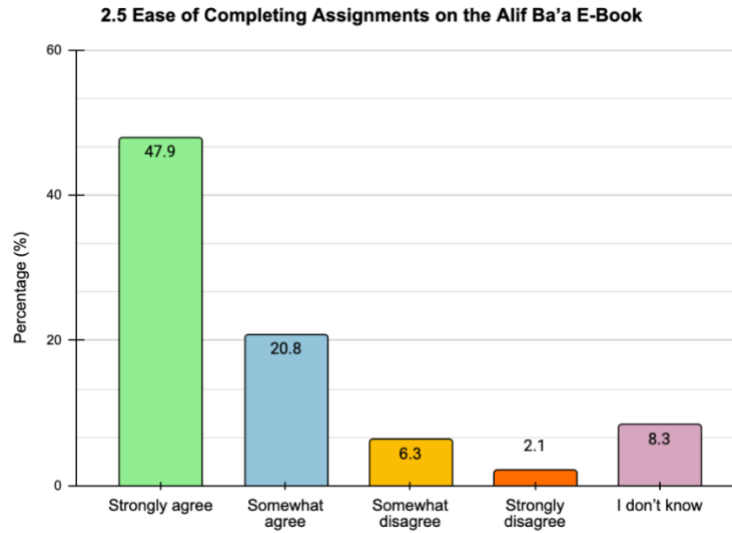


Figure 47: Ease of Completing Assignments

The responses regarding the ease of navigating through the interactive activities on the Alif Ba'a e-book, as shown in Figure 48, indicated a positive perception. Half of the participants, 50.0% (n=24), strongly agreed, while 27.1% (n=13) somewhat agreed, resulting in a combined agreement of 77.1%. A smaller portion, 4.2% (n=2), somewhat disagreed, while 2.1% (n=1) strongly disagreed, and another 2.1% (n=1) selected "I don't know". These findings suggested that most participants found navigating interactive activities intuitive and user-friendly, with minimal negative or uncertain feedback.

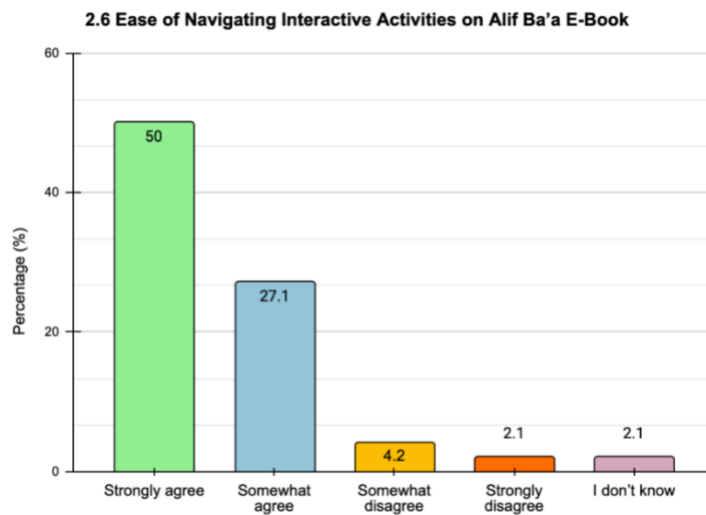


Figure 48: Ease of Navigating Interactive Activities

The responses regarding the ease of submitting assignments via the Alif Ba'a e-book indicated a positive reception overall (see Figure 49). A majority of participants, 52.1% (n=25), strongly agreed, while 18.8% (n=9) somewhat agreed, resulting in a combined agreement of 70.9%. A smaller portion, 6.3% (n=3), somewhat disagreed, while 2.1% (n=1) strongly disagreed, and another 6.3% (n=3) selected "I don't know". These findings suggested that while most found assignment submission easy, a noticeable subset expressed mixed experiences or uncertainty regarding this feature.

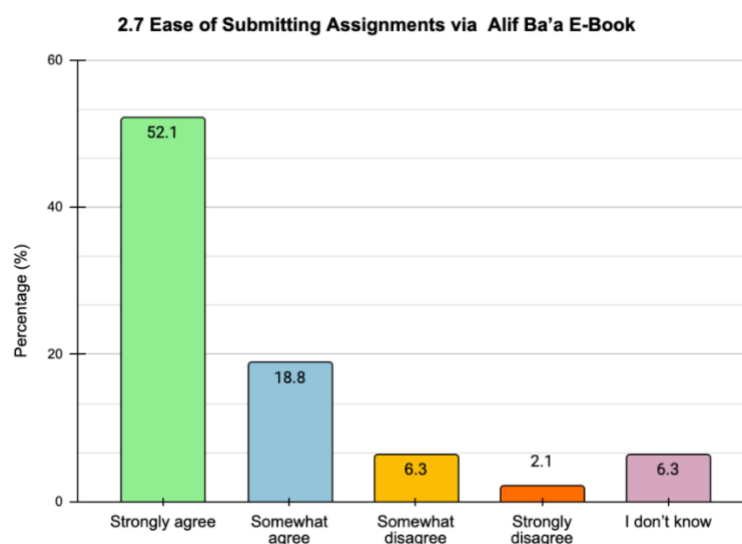


Figure 49: Ease of Submitting Assignments

The responses regarding confidence in using the Alif Ba'a e-book to learn the Arabic alphabet, as shown in Figure 50, demonstrated a strong positive sentiment. A majority of participants, 52.1% (n=25), strongly agreed, while 22.9% (n=11) somewhat agreed, resulting in a combined agreement of 75.0%. A small portion, 2.1% (n=1), strongly disagreed, and 8.3% (n=4) selected "I don't know", indicating some uncertainty. These findings suggested that while the e-book inspired confidence among most users, a small subset remained uncertain or less confident about its effectiveness for learning.

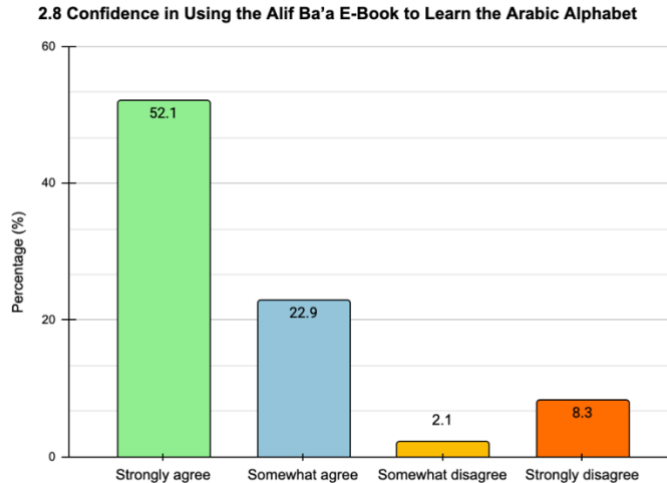


Figure 50: Confidence in Using the E-Book

The responses regarding the ease of using the Alif Ba'a e-book (see Figure 51) indicated overwhelmingly positive feedback. Most participants, 52.1% (n=25), strongly agreed that the e-book was easy to use. In comparison, 27.1% (n=13) somewhat agreed, resulting in a combined agreement of 79.2%, which reflected the total percentage of participants who either strongly or somewhat agreed. Only a small percentage, 2.1% (n=1) each, somewhat disagreed, strongly disagreed, or selected “I don’t know”. The results highlighted the e-book’s user-friendly design and its effectiveness as an accessible and easy-to-navigate learning tool, with few negative responses from participants, suggesting it could serve as a model for future educational tools.

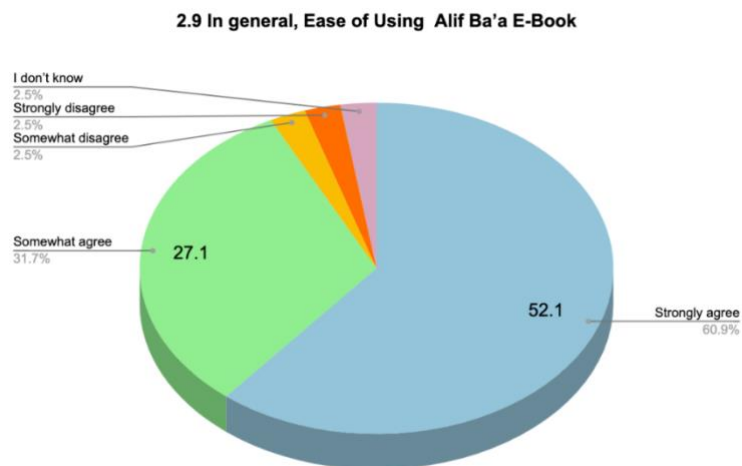


Figure 51: Ease of Using the E-Book

6.7.1.3 Intention to Use the Alif Ba'a E-book

Figure 52 indicates a strong positive attitude towards the Alif Ba'a e-book for learning Arabic, with most participants intending to use it. There is high support for it as a practical tool for mastering the Arabic alphabet. The findings highlighted the acceptance and effectiveness of digital learning resources in language education, with participants expressing confidence in their ability to enhance Arabic language acquisition.

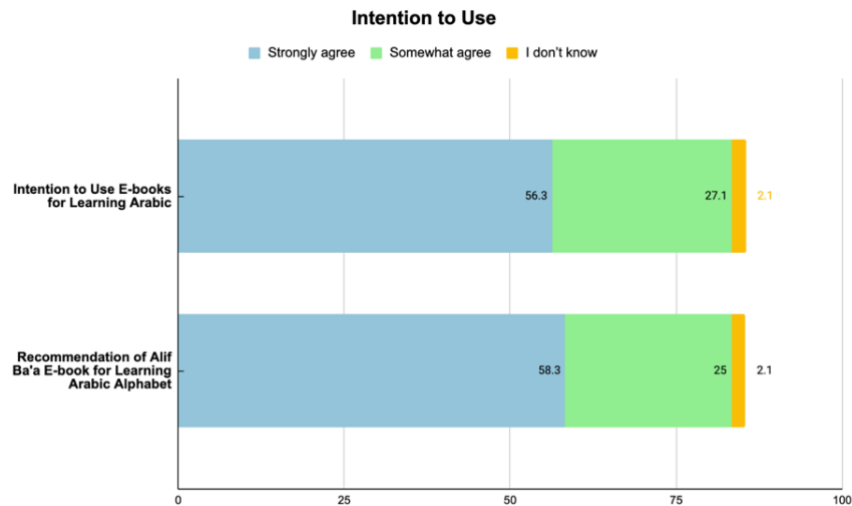


Figure 52: Intention to Use

The responses regarding the intent to use the Alif Ba'a e-book to learn Arabic (see Figure 53) indicated a strong positive outlook. Most participants, 56.3% (n=27), strongly agreed with the intent to use the Alif Ba'a e-book, while 27.1% (n=13) somewhat agreed. Together, these result in a combined agreement of 83.4%. A small percentage, 2.1% (n=1), selected "I don't know", reflecting minimal uncertainty. These findings highlighted that most respondents saw the Alif Ba'a e-book as a valuable resource for learning Arabic.

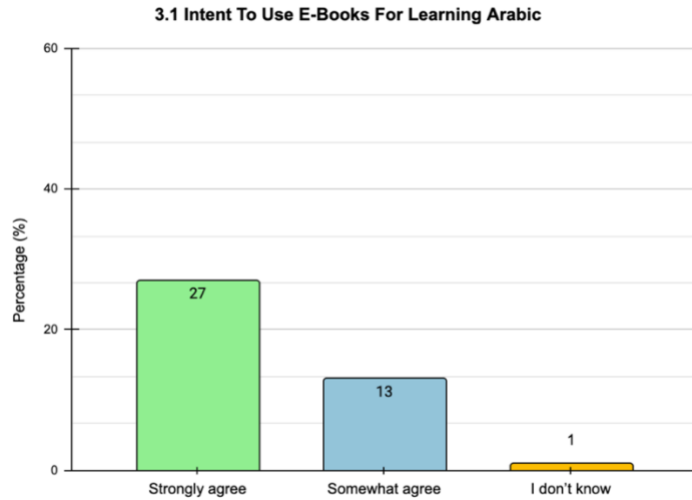


Figure 53: Intention to Use E-Book for Learning Arabic

The responses regarding recommending the Alif Ba'a e-book to others for learning the Arabic Alphabet showed strong agreement (see Figure 54). Most participants, 58.3% (n=28), strongly agreed to recommend the e-book, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement of 83.3%. A small percentage, 2.1% (n=1), selected "I don't know", reflecting minimal uncertainty. These findings indicated that the e-book is widely seen as a valuable and recommended resource for learning the Arabic Alphabet.

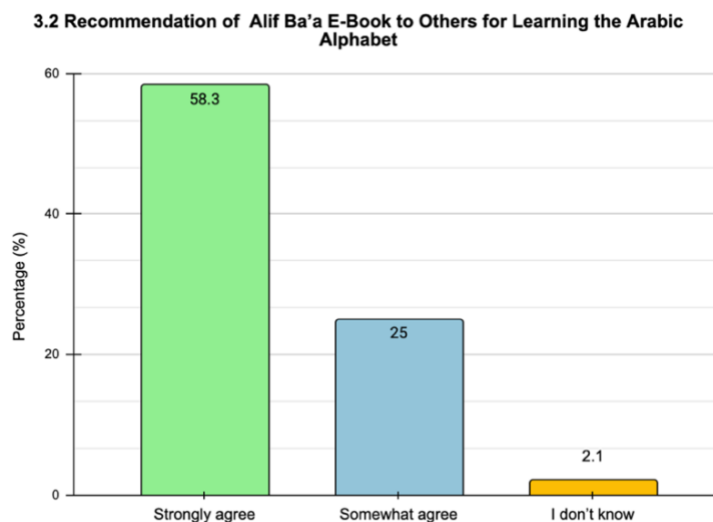


Figure 54: Recommendation of the E-Book to Others

6.7.1.4 Convenience

As shown in Figure 55, participants reported strong perceptions of the e-book’s convenience. Agreement (strongly + somewhat) was high for convenience in practising the alphabet (79.2%), saving time and effort (62.5%), an enjoyable learning experience (68.8%), accessibility (anytime/anywhere; 72.9%), consistency with learning goals (77.1%), and content suitability (75.0%). By contrast, 56.3% agreed there were challenges in the interactive activities, signalling a key area for improvement. Overall, the e-book was well received as a convenient tool for learning Arabic.

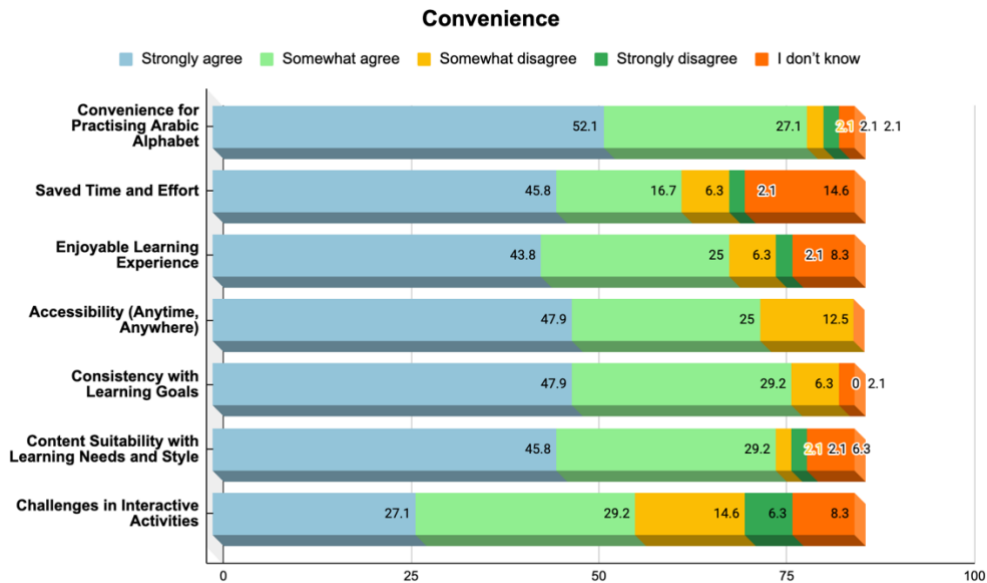


Figure 55: Convenience

Figure 56 shows that the responses regarding the convenience of the Alif Ba’a e-book for practising reading and writing the Arabic Alphabet indicated strong agreement. A majority of participants, 52.1% (n=25), strongly agreed that the e-book was convenient, while 27.1% (n=13) somewhat agreed, leading to a combined agreement of 79.2%. A small portion, 2.1% (n=1), somewhat disagreed, strongly disagreed, or selected “I don’t know”, reflecting minimal dissatisfaction or uncertainty. These findings suggest that most participants found the e-book to be a convenient tool for learning.

4.1 Convenience of Alif Ba'a E-Book for Practicing Reading and Writing Arabic Alphabet

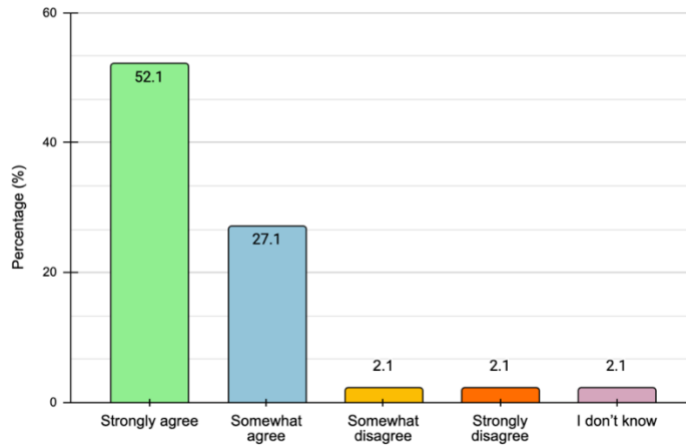


Figure 56: Convenience for Practising Reading and Writing the Alphabet

Figure 57 shows the responses regarding the Alif Ba'a e-book's ability to save time and effort compared to other learning resources, indicating a generally positive perception. Among participants, 45.8% (n=22) strongly agreed, while 16.7% (n=8) somewhat agreed, culminating in a combined agreement of 62.5%. A smaller portion, 6.3% (n=3), somewhat disagreed, 2.1% (n=1) strongly disagreed, and 14.6% (n=7) selected "I don't know", reflecting some uncertainty. These findings suggest that while the majority perceived the e-book as an efficient tool for learning, a notable minority expressed reservations or uncertainty about its time-saving effectiveness.

4.2 Time and Effort-Saving Ability of Alif Ba'a E-Book Compared to Other Resources

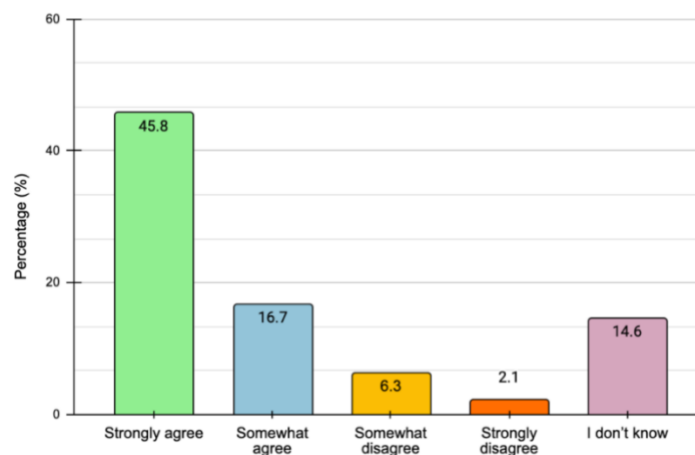


Figure 57: Time and Effort-Saving Ability of the E-Book

The responses regarding the enjoyable learning experience with the Alif Ba'a e-book showed a predominantly positive perception, as shown in Figure 58. Among participants, 43.8% (n=21) strongly agreed, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement of 68.8%. A smaller proportion, 6.3% (n=3), somewhat disagreed, 2.1% (n=1) strongly disagreed, and 8.3% (n=4) selected "I don't know", indicating some uncertainty. These findings suggest that while most participants enjoyed the learning experience, a smaller subset expressed mixed or uncertain views.

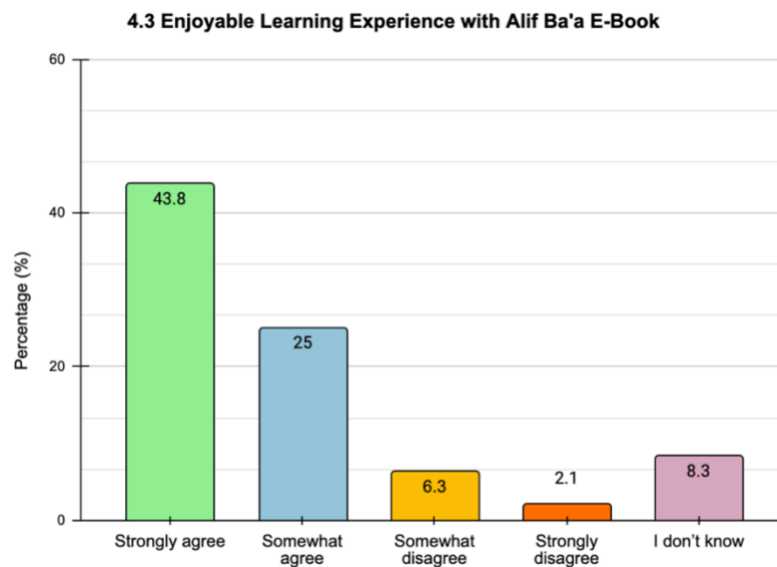


Figure 58: Enjoyable Learning Experience

The responses regarding the accessibility of the Alif Ba'a e-book anytime and anywhere (see Figure 59) reflected a predominantly positive perception. Nearly half of the participants, 47.9% (n=23), strongly agreed, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement of 72.9%. A smaller proportion, 12.5% (n=6), somewhat disagreed, indicating some challenges or limitations in accessibility. The findings showed that while the e-book was generally seen as accessible, some users faced difficulties in its usability.

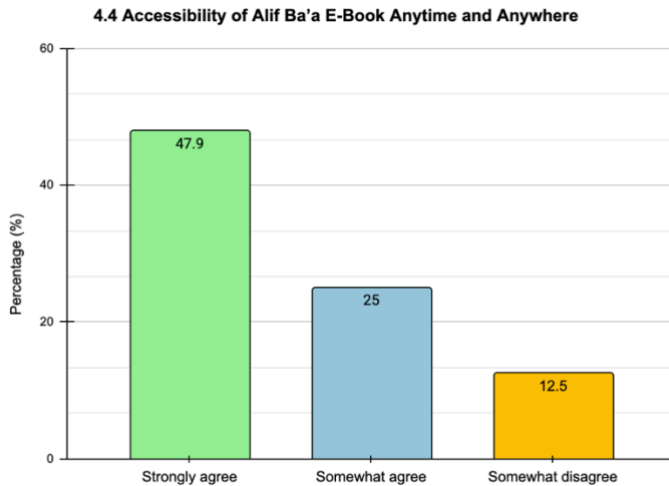


Figure 59: Accessibility of the E-Book

As shown in Figure 60, the responses regarding the consistency of the Alif Ba'a e-book with participants' learning goals and objectives reflected a predominantly positive outlook. Nearly half of the participants, 47.9% (n=23), strongly agreed, while 29.2% (n=14) somewhat agreed, resulting in a combined agreement of 77.1%. A smaller proportion, 6.3% (n=3), somewhat disagreed, while 2.1% (n=1) selected "I don't know", indicating minimal uncertainty. These findings suggested that the e-book aligned well with the educational objectives of most participants, with only a small subset expressing doubts about its alignment with their goals.

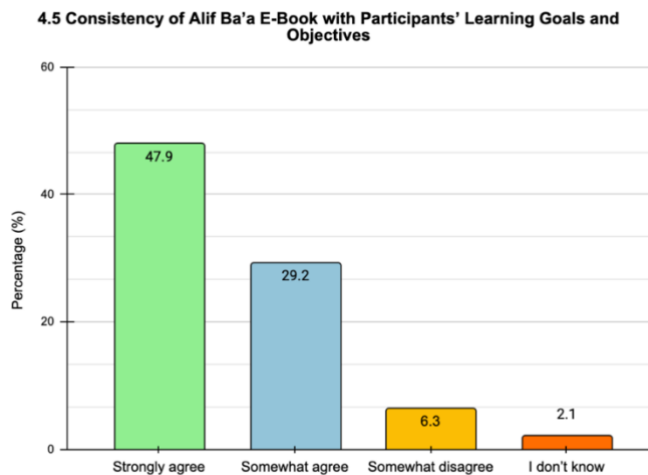


Figure 60: Consistency of the E-Book with Learning Goals and Objectives

Figure 61 shows that the responses regarding the suitability of the Alif Ba'a e-book content with participants' learning needs and preferences indicated a generally positive sentiment. A substantial proportion, 45.8% (n=22), strongly agreed, while 29.2% (n=14) somewhat agreed, resulting in a combined agreement of 75.0%. A small proportion, 2.1% (n=1), somewhat disagreed or strongly disagreed, while 6.3% (n=3) selected "I don't know", indicating minimal uncertainty. These findings suggested that the Alif Ba'a e-book's content was well-aligned with most participants' educational needs and preferences.

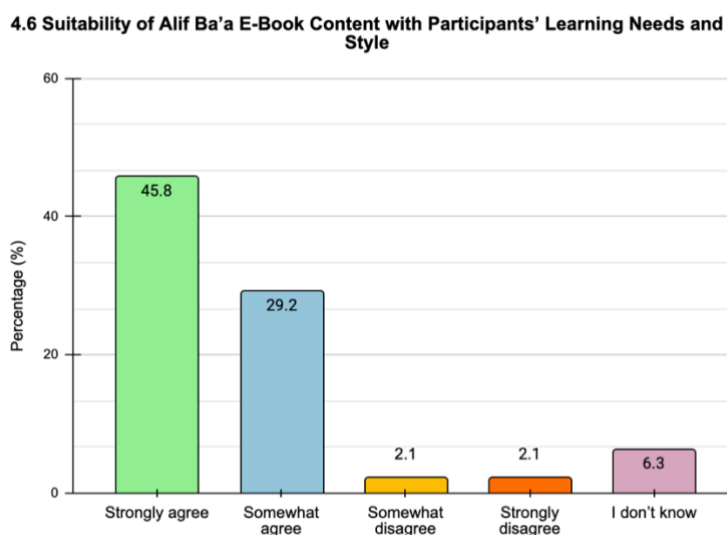


Figure 61: Suitability of the E-Book Content with Participants' Learning Needs and Preferences

I identified a significant division in students' experiences regarding the challenges they faced while completing interactive activities on the Alif Ba'a e-book (see Figure 62). Analysis of the results showed that a combined majority comprising 27.1% (n=13) who strongly agreed and 29.2% (n=14) who somewhat agreed. Conversely, I identified a minority that did not share this perception, with 14.6% (n=7) who somewhat disagreed, and 6.3% (n=3) who strongly disagreed, while 8.3% (n=4) remained uncertain. These findings indicated that while the activities were engaging, they required further instructional scaffolding to reduce unnecessary task difficulty.

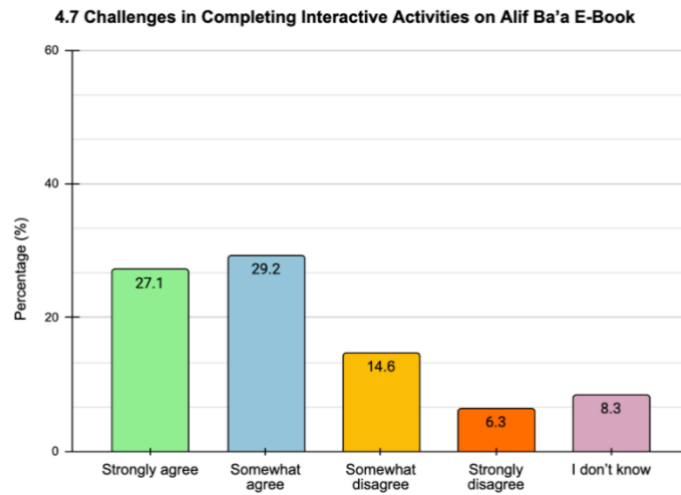


Figure 62: Challenges in Completing Interactive Activities

The responses regarding the extent to which the Alif Ba'a e-book met participants' expectations for learning the Arabic alphabet, as shown in Figure 63, indicated overwhelmingly positive feedback. A majority, 58.3% (n=28), strongly agreed that the e-book met their expectations, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement of 83.3%. A small percentage, 2.1% (n=1), strongly disagreed, reflecting minimal dissatisfaction. These findings demonstrated that the e-book successfully aligned with the learning expectations of most participants, establishing its effectiveness as a learning resource.

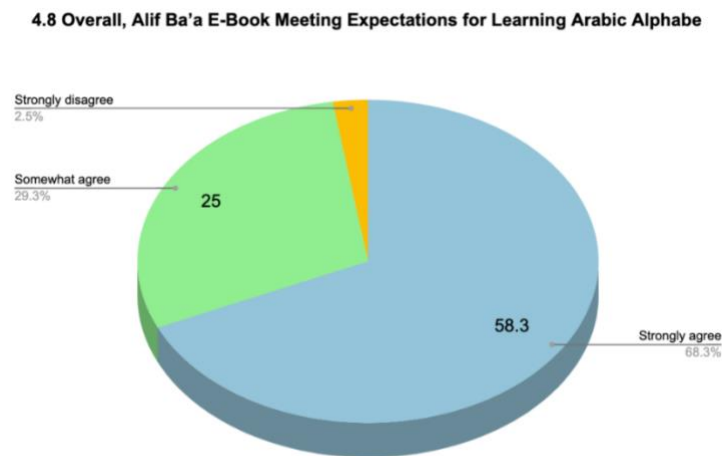


Figure 63: Overall, the E-Book Meeting Expectations

6.7.1.5 Compatibility

The feedback indicated a largely positive perception of the Alif Ba'a e-book's compatibility. Most participants found it aligned with their technological skills, learning preferences, and devices. As shown in Figure 64, the e-book was praised for its seamless integration with existing technology and its compatibility with various operating systems and devices. Overall satisfaction was notably high, with minimal disagreement reported, demonstrating that it met or exceeded most users' expectations.

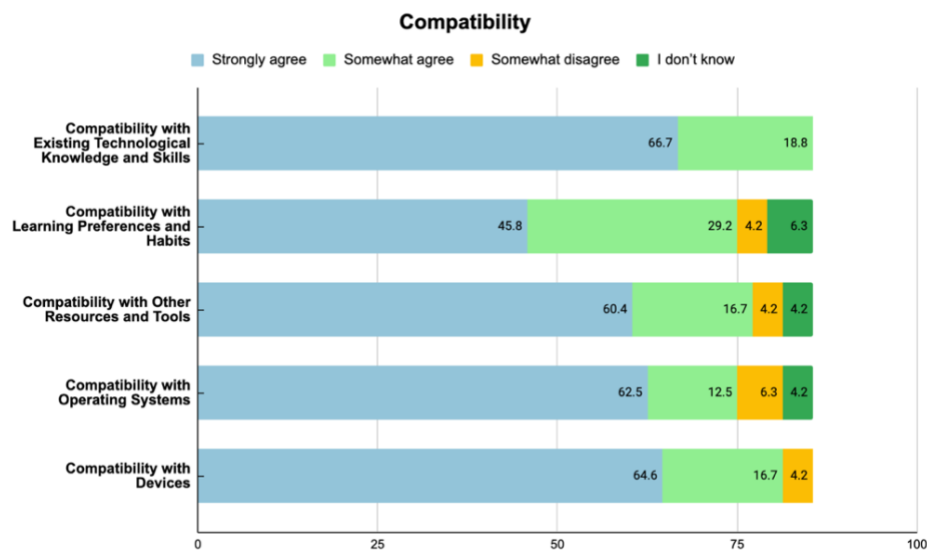


Figure 64: Compatibility

Figure 65 shows that the feedback regarding the compatibility of the Alif Ba'a e-book with participants' existing technological knowledge and skills indicated an overwhelmingly positive reception. A significant majority, 66.7% (n=32), strongly agreed, while 18.8% (n=9) somewhat agreed, resulting in a combined agreement of 85.5%. These findings suggested that the e-book was highly compatible with users' technological skills, facilitating a smooth and accessible learning experience.

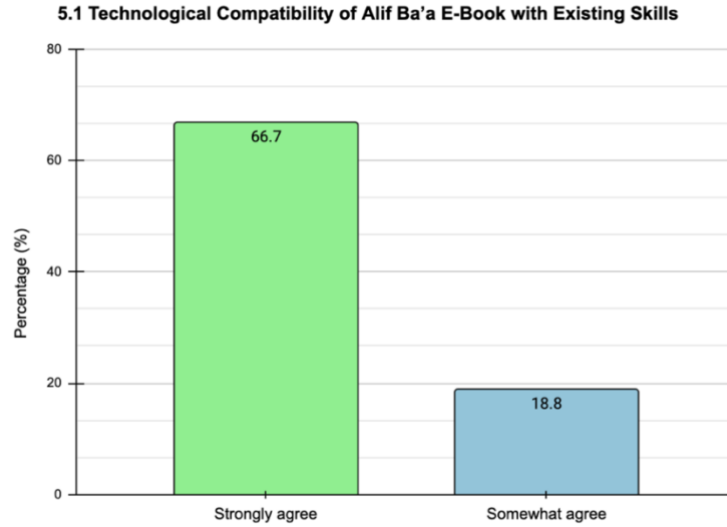


Figure 65: Technological Compatibility of the E-Book

The responses regarding the extent to which the Alif Ba'a e-book aligned with participants' learning preferences and habits indicated a largely positive perception, as shown in Figure 66. A significant proportion, 45.8% (n=22), strongly agreed, while 29.2% (n=14) somewhat agreed, resulting in a combined agreement of 75%. A smaller proportion, 4.2% (n=2), somewhat disagreed, while 6.3% (n=3) selected "I don't know", indicating minimal uncertainty. These findings suggested that the e-book's approach was well-suited to the preferences and habits of most participants, with minimal disagreement or doubt expressed.

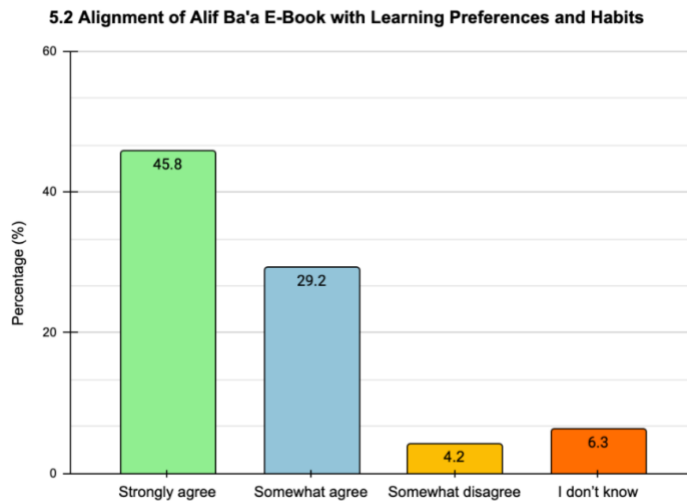


Figure 66: Alignment of the E-Book with Learning Preferences

The responses regarding how the Alif Ba'a e-book complemented other resources and tools for learning Arabic indicated a strong positive perception, as shown in Figure 67. A majority, 60.4% (n=29), strongly agreed, while 16.7% (n=8) somewhat agreed, resulting in a combined agreement of 77.1%. A smaller proportion, 4.2% (n=2), somewhat disagreed, while an equal percentage selected "I don't know", reflecting minimal disagreement or uncertainty. These findings suggested that the e-book was widely viewed as a valuable supplementary tool for Arabic learning resources.

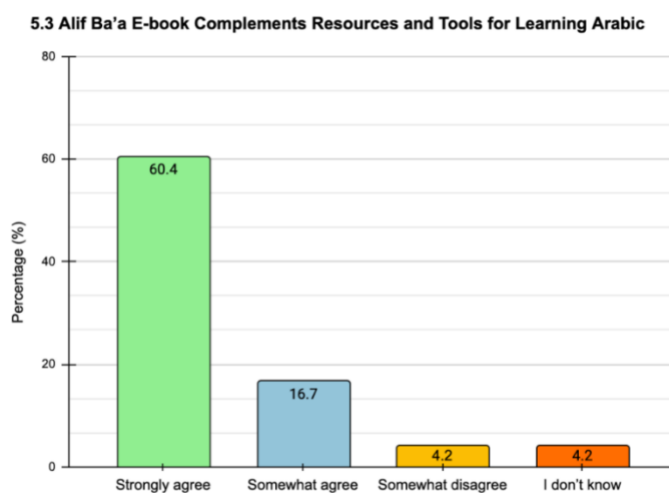


Figure 67: The E-book Complements Resources and Tools

Figure 68 shows that the responses regarding the compatibility of the Alif Ba'a e-book with participants' operating systems reflected a highly positive perception. A substantial majority, 62.5% (n=30), strongly agreed, while 12.5% (n=6) somewhat agreed, resulting in a combined agreement of 75%. A smaller proportion, 6.3% (n=3), somewhat disagreed, and 4.2% (n=2) selected "I don't know", indicating minimal disagreement or uncertainty. These findings suggested that the e-book was highly compatible with diverse operating systems, providing a seamless user experience for most participants.

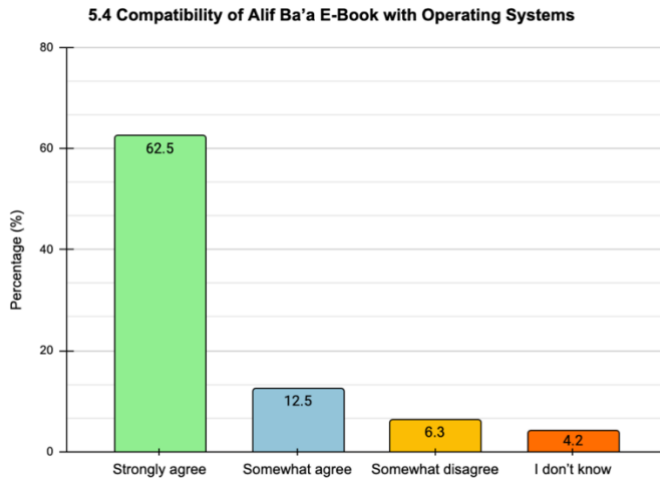


Figure 68: Compatibility of E-Book with Operating Systems

Figure 69 summarises participants' evaluations regarding the compatibility of the Alif Ba'a e-book with their devices. The data indicated a strong positive reception, with 64.6% of respondents (n=31) expressing strong agreement and an additional 16.7% (n=8) indicating somewhat of an agreement. This resulted in a total agreement rate of 75.6%. A small segment of participants, specifically 4.2% (n=2), somewhat disagreed with the compatibility. The findings indicated that most users found the e-book highly compatible with their devices, showing minimal usability barriers. Notably, 95.1% of respondents either agreed or remained neutral.

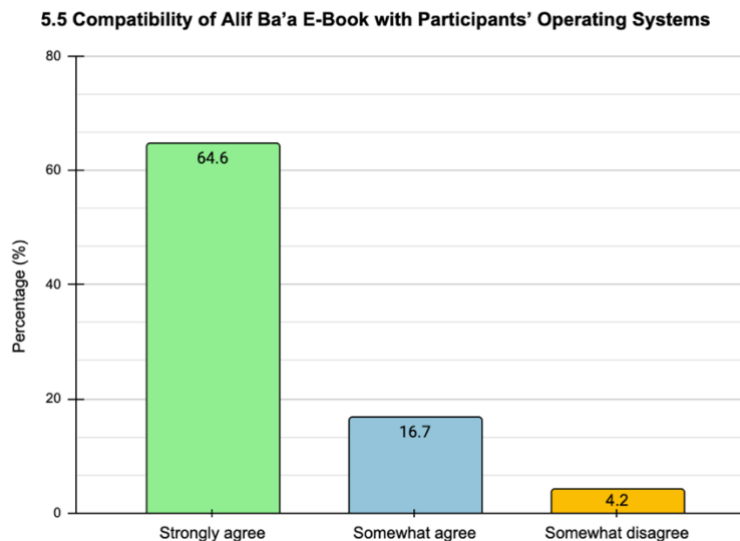


Figure 69: Compatibility of the E-Book with Participants' Operating Systems

The feedback regarding overall satisfaction with the compatibility of the Alif Ba'a e-book, as shown in Figure 70, demonstrated a predominantly positive sentiment. A significant majority of participants, 60.4% (n=29), expressed strong agreement with their satisfaction, while 20.8% (n=10) somewhat agreed, leading to a combined agreement rate of 91.2%. A small portion, 2.1% (n=1), somewhat disagreed and strongly disagreed. These findings highlighted the effectiveness of the e-book's compatibility features, indicating that it performed well across various user devices and technological environments. The accompanying chart visually reinforces the prevalence of positive responses, showcasing the high level of user satisfaction regarding this aspect of the e-book.

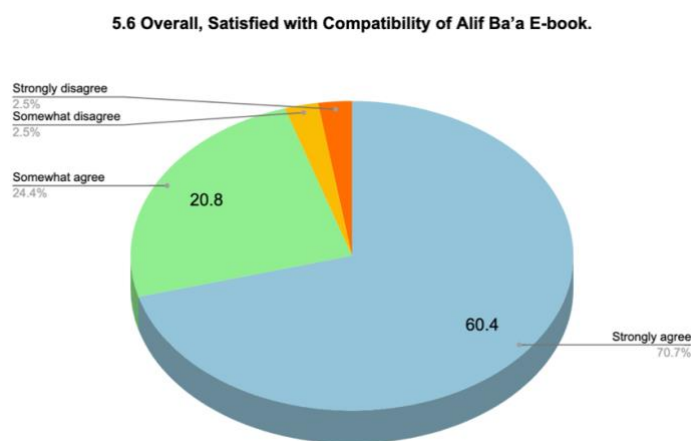


Figure 70: Satisfaction with Compatibility of the E-book

6.7.1.6 Media Richness in the Alif Ba'a E-book

The media richness analysis of the Alif Ba'a e-book shows strong positive feedback, as shown in Figure 71. Participants praised the effectiveness of the visual/audio aids in enriching the learning experience. The design was noted for its visual appeal, user-friendliness, and appropriateness for learners' proficiency levels. Additionally, the high audio quality and interactive elements contributed to an engaging environment, although a few expressed mixed opinions. Overall, the diverse media elements were seen as a key strength, resulting in high user satisfaction and demonstrating the e-book's effectiveness in supporting Arabic language acquisition.

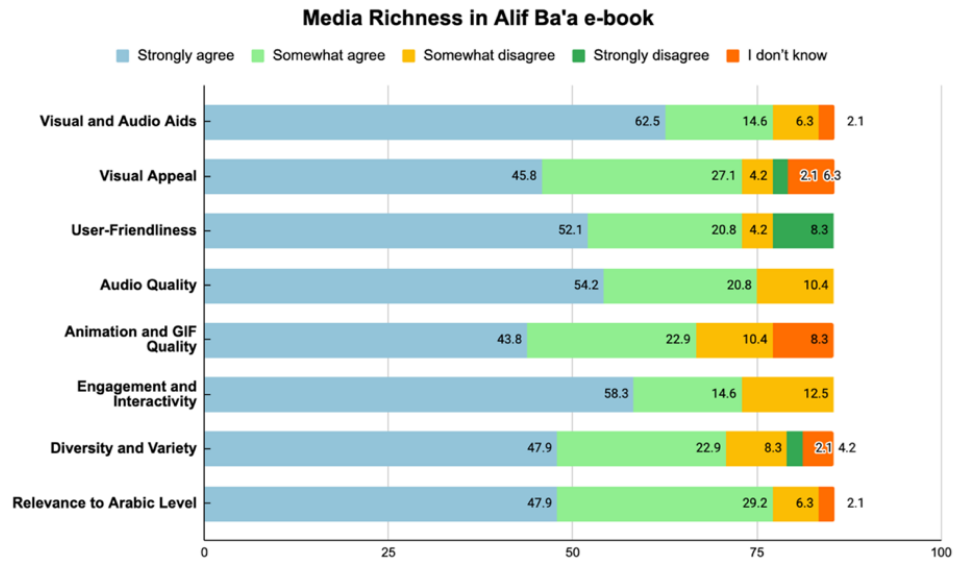


Figure 71: Media Richness in the E-book

Figure 72 shows that the responses regarding the media richness of visual/audio aids in the Alif Ba'a e-book reflected strong positive feedback. A significant majority, 62.5% (n=30), strongly agreed, while 14.6% (n=7) somewhat agreed, resulting in a combined agreement of 77.1%. A smaller proportion, 6.3% (n=3), somewhat disagreed, and 2.1% (n=1) selected “I don't know”, indicating minimal disagreement or uncertainty. These findings suggested that the visual/audio components of the e-book significantly enhanced learning experience.

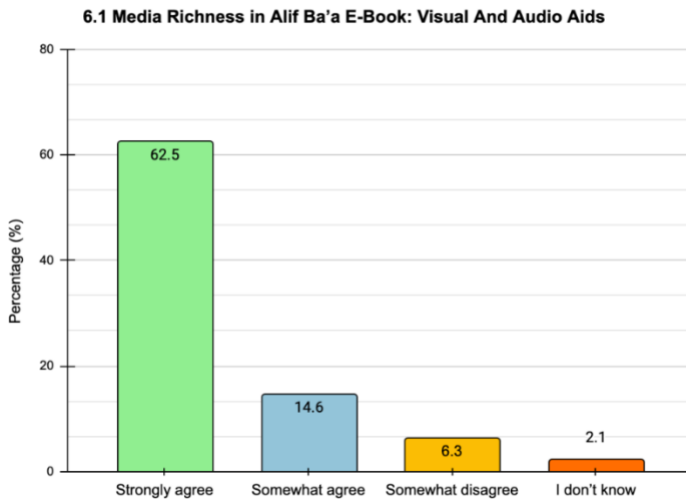


Figure 72: Media Richness in the E-Book: Visual and Audio Aids

The feedback regarding the visual appeal of the media in the Alif Ba'a e-book for practising the Arabic alphabet (see Figure 73) indicated a predominantly positive perception. A significant proportion, 45.8% (n=22), strongly agreed, while 27.1% (n=13) somewhat agreed, resulting in a combined agreement of 72.9%. A smaller proportion, 4.2% (n=2), somewhat disagreed, 2.1% (n=1) strongly disagreed, and 6.3% (n=3) selected "I don't know", reflecting some uncertainty or disagreement. These findings suggested that most participants found the e-book's visual media appealing and supportive of their learning process.

6.2 Visual Appeal of Media In Alif Ba'a E-Book For Practicing The Arabic Alphabet

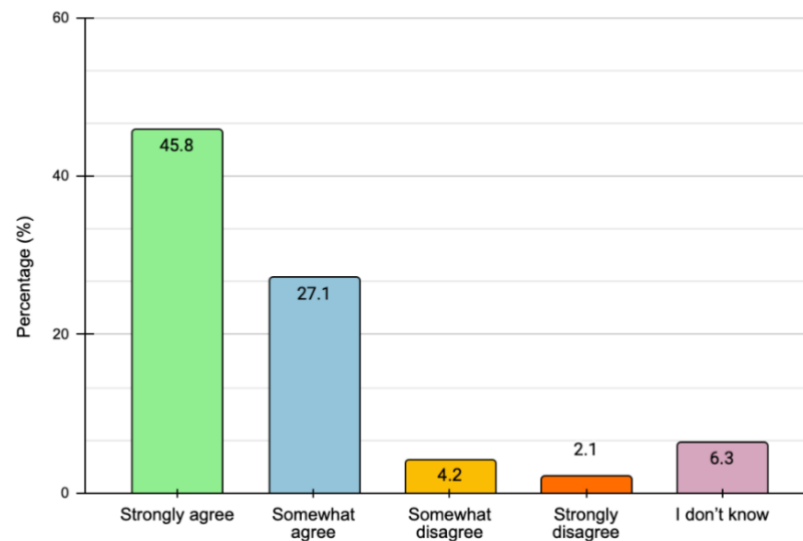


Figure 73: Visual Appeal of Media in the E-Book

The responses on the user-friendliness of the Alif Ba'a e-book interface revealed a notably positive reception among participants, as shown in Figure 74. A significant majority, 52.1% (n=25), strongly agreed that the interface was user-friendly, while 20.8% (n=10) somewhat agreed, resulting in a total agreement rate of 85.4%. Conversely, a smaller group, 4.2% (n=2), somewhat disagreed, and 8.3% (n=4) chose "I don't know", indicating minimal dissatisfaction or uncertainty. These findings underscored that the e-book's interface was well-received, emphasising its role in providing an accessible and effective learning experience.

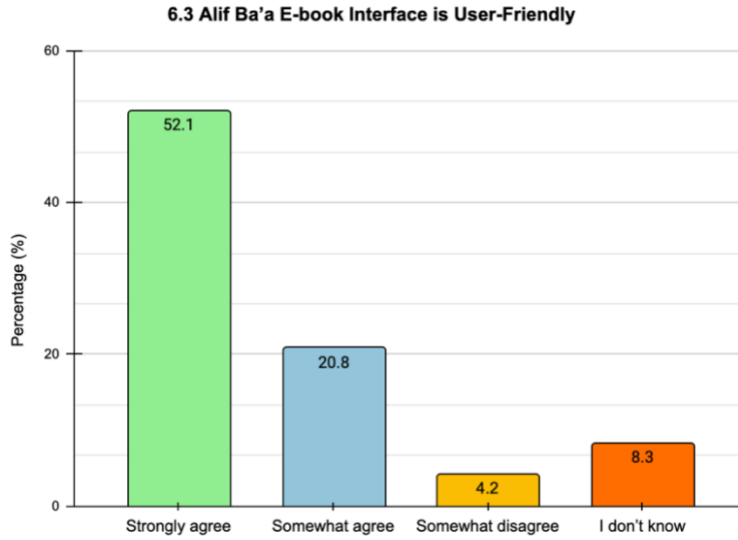


Figure 74: The E-book Interface

Figure 75 shows that the responses regarding the usefulness of the audio quality in the Alif Ba'a e-book reflected a largely positive sentiment. A majority, 54.2% (n=26), strongly agreed, while 20.8% (n=10) somewhat agreed, resulting in a combined agreement of 75.0%. A smaller proportion, 10.4% (n=5), somewhat disagreed, indicating some dissatisfaction. These findings suggested that the audio quality was a significant and useful feature for most participants, with minimal negative feedback.

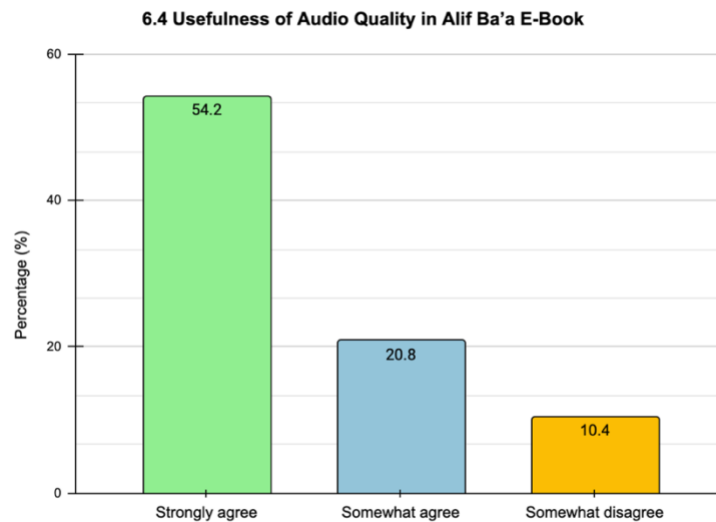


Figure 75: Usefulness of Audio Quality

Figure 76 shows that the feedback on the animation and GIF quality in the Alif Ba'a e-book revealed a predominantly positive sentiment. A significant proportion, 43.8% (n=21), strongly agreed with its effectiveness, while 22.9% (n=11) somewhat agreed, resulting in an overall agreement rate of 68.0%. However, a smaller group of participants expressed some reservations, with 10.4% (n=5) somewhat disagreeing and 8.3% (n=4) selecting “I don't know”, indicating either uncertainty or minor dissatisfaction. These findings suggested that, although the majority found the animation and GIF quality beneficial for practising the Arabic alphabet, there remained a minority with mixed opinions about its effectiveness.



Figure 76: Usefulness of GIF Quality

The responses to the statement, “The media in the Alif Ba'a e-book were engaging and interactive”, revealed a strong consensus among participants (see Figure 77). A significant majority, 58.3% (n=28), strongly agreed, while 14.6% (n=7) somewhat agreed, leading to an overall agreement level of 73.0%. Conversely, 12.5% (n=6) somewhat disagreed. These cumulative percentages indicated a predominantly positive reception of the media's interactive and engaging attributes.

6.6 Media in Alif Ba'a E-book are Engaging and Interactive.

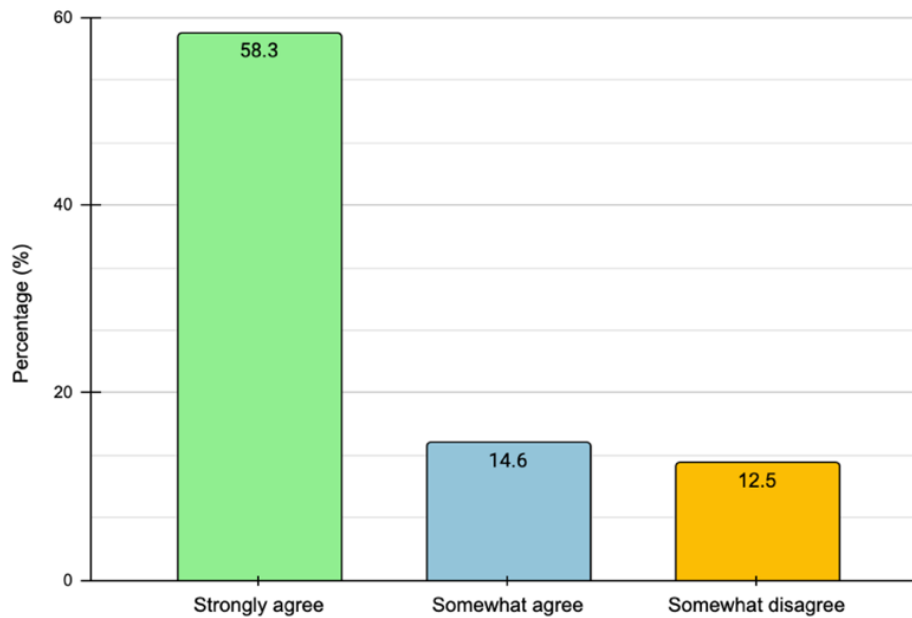


Figure 77: Media are Engaging and Interactive

These findings implied that the media components of the e-book were largely viewed as effective in enhancing the learning experience, with only a small segment expressing any reservations. The overwhelmingly positive feedback highlights the e-book's success in actively utilising interactivity to engage its users.

The responses regarding the diversity and variety of media in the Alif Ba'a e-book showed a generally positive perception, as shown in Figure 78. A significant proportion, 47.9% (n=23), strongly agreed, while 22.9% (n=11) somewhat agreed, resulting in a combined agreement of 70.8%. A smaller portion, 8.3% (n=4), somewhat disagreed, while 2.1% (n=1) strongly disagreed and 4.2% (n=2) selected "I don't know", reflecting some disagreement or uncertainty. These findings suggested that while most participants viewed the media in the e-book as diverse and varied, a small group expressed doubts or differing opinions.

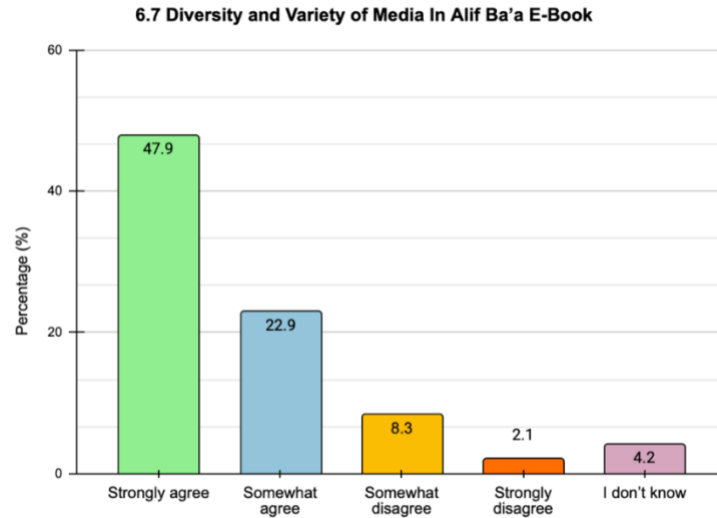


Figure 78: Diversity of Media

Figure 79 shows that the responses regarding the relevance of the media in the Alif Ba'a e-book to the Arabic language level reflected a positive sentiment. A significant proportion, 47.9% (n=23), strongly agreed, while 29.2% (n=14) somewhat agreed, resulting in a combined agreement of 77.1%. A smaller proportion, 6.3% (n=3), somewhat disagreed, while 2.1% (n=1) selected "I don't know", reflecting minimal disagreement or uncertainty. These findings suggested that most participants found the media in the e-book to be well-aligned with their Arabic language learning level, with only minor disagreement or ambiguity.

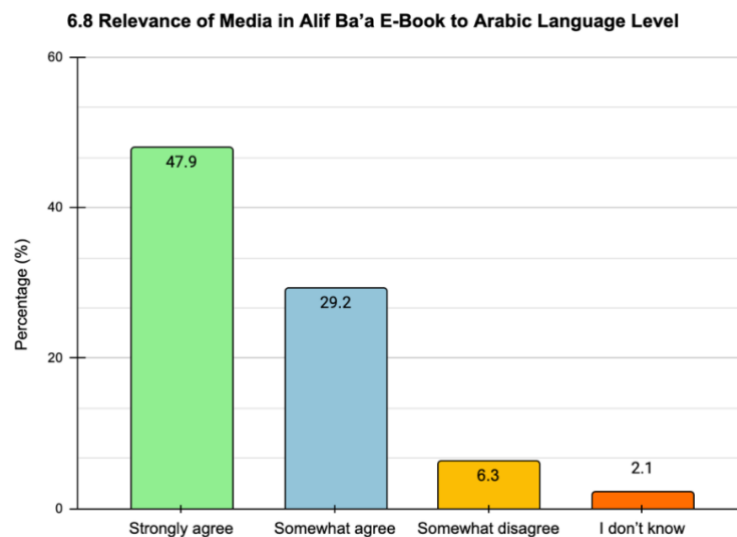


Figure 79: Relevance of Media in the E-Book to Arabic Language Level

The responses regarding overall satisfaction with the media richness in the Alif Ba'a e-book, as shown in Figure 80, indicated strong positive feedback. Half of the participants, 50.0% (n=24), strongly agreed, while 31.3% (n=15) somewhat agreed, resulting in a combined agreement of 81.3%. A very small proportion, 2.1% (n=1) each, somewhat disagreed or strongly disagreed, reflecting minimal dissatisfaction. These findings highlighted that the media richness of the e-book was a key strength and highly appreciated by most participants.

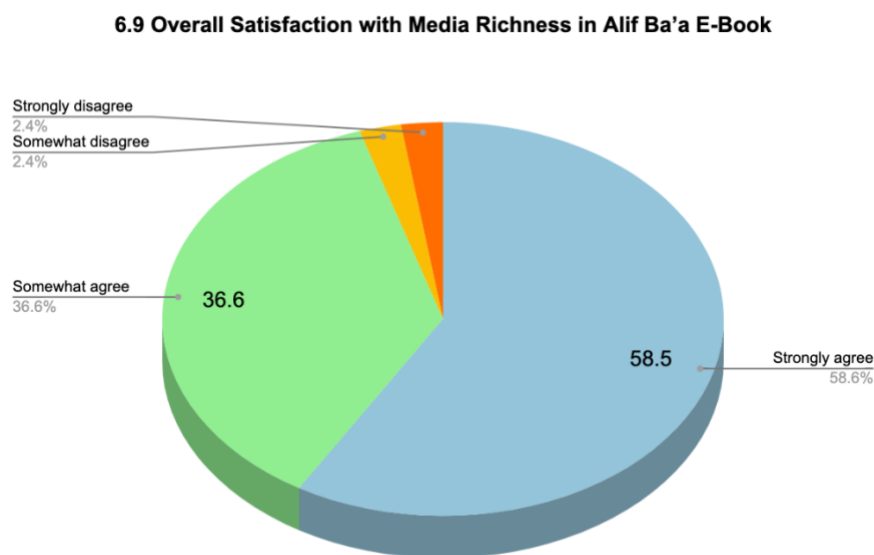


Figure 80: Overall Satisfaction with Media Richness

6.7.1.7 The Alif Ba'a E-book Interactivity

The analysis of participant feedback on the Alif Ba'a e-book showed a positive response to its interactive features. Figure 81 shows that most students found the activities engaging and effective, contributing significantly to their understanding of the Arabic alphabet. While the "Practice" section received favourable reviews, the "Produce" section raised some uncertainty. Overall, the e-book's interactivity was successful in enhancing the user

experience and facilitating language acquisition, despite mixed feedback.

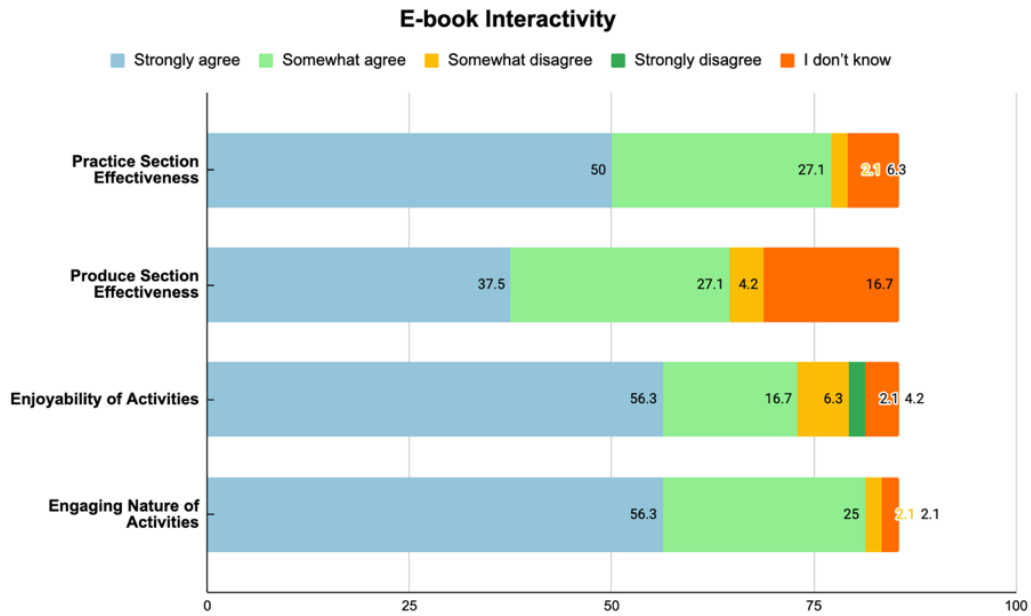


Figure 81: The E-book Interactivity

The feedback concerning the interactive activities in the “Practice” section of the Alif Ba’a e-book revealed a predominantly positive response. Figure 82 shows that half of the participants (50.0%, n=24) strongly agreed that these activities effectively aided their learning of the Arabic alphabet, while 27.1% (n=13) somewhat agreed, resulting in a combined agreement rate of 85.4%. A small percentage, 2.1% (n=1), somewhat disagreed, and 6.3% (n=3) chose “I don’t know”, indicating minimal disagreement or uncertainty. The cumulative percentage data demonstrated a positive trend, highlighting the broad acceptance of interactive activities as effective learning tools. The overwhelmingly positive response emphasised the e-book’s effectiveness in providing engaging and practical activities designed to support learning the Arabic alphabet, reflecting its usability and alignment with educational goals.

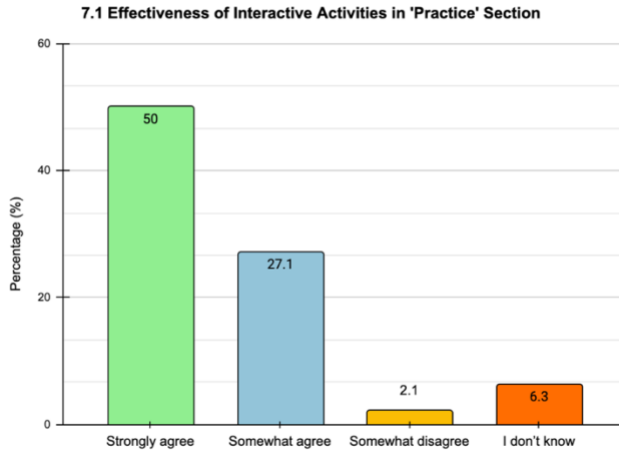


Figure 82: Effectiveness of Interactive Activities in the 'Practice' Section

The feedback regarding the effectiveness of the interactive activities in the “Produce” section of the Alif Ba’a e-book (see Figure 83) indicated a moderately positive perception overall. Among participants, 37.5% (n=18) strongly agreed, and 27.1% (n=13) somewhat agreed, leading to a total agreement rate of 71.6%. Conversely, 4.2% (n=2) somewhat disagreed, while 16.7% (n=8) chose “I don’t know”, which revealed a significant level of uncertainty or mixed experiences. These results suggested that while the majority found the “Produce” section effective for their learning, a notable proportion expressed reservations or could not form a definitive opinion regarding its utility. This highlights an opportunity to enhance these activities further to improve clarity and user engagement.

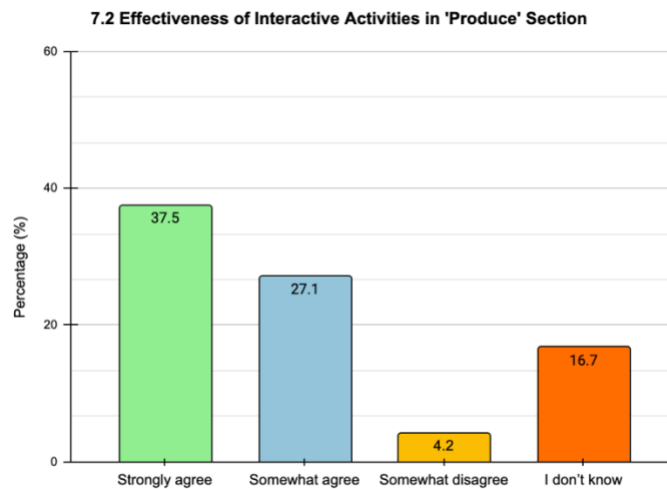


Figure 83: Effectiveness of Interactive Activities in the 'Produce' Section

The responses regarding enjoying interactive activities in the Alif Ba'a e-book reflected a predominantly positive perception, as shown in Figure 84. A majority, 56.3% (n=27), strongly agreed, while 16.7% (n=8) somewhat agreed, resulting in a combined agreement of 73.0%. A smaller portion, 6.3% (n=3), somewhat disagreed, 2.1% (n=1) strongly disagreed, and 4.2% (n=2) selected "I don't know", indicating some uncertainty or disagreement. These findings highlighted that most participants found the interactive activities enjoyable and engaging, with more minimal dissatisfaction or ambiguity.

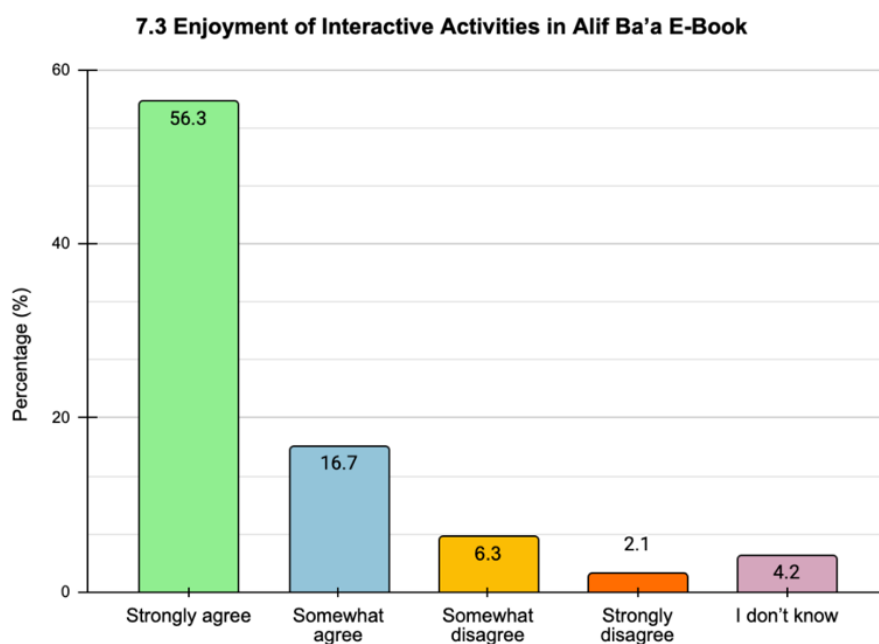


Figure 84: Enjoyment of Interactive Activities in the E-Book

The feedback on the statement "The interactive activities in the Alif Ba'a e-book were engaging" revealed a predominantly positive perception among participants, as shown in Figure 85. A notable majority, 56.3% (n=27), expressed strong agreement, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement rate of 91.3%. Only a small number, 2.1% (n=1), somewhat disagreed, with an equal percentage indicating uncertainty by selecting "I don't know". These results highlighted the engaging nature of the e-book's interactive activities, emphasising their contribution to enhanced user engagement and overall learning experience.

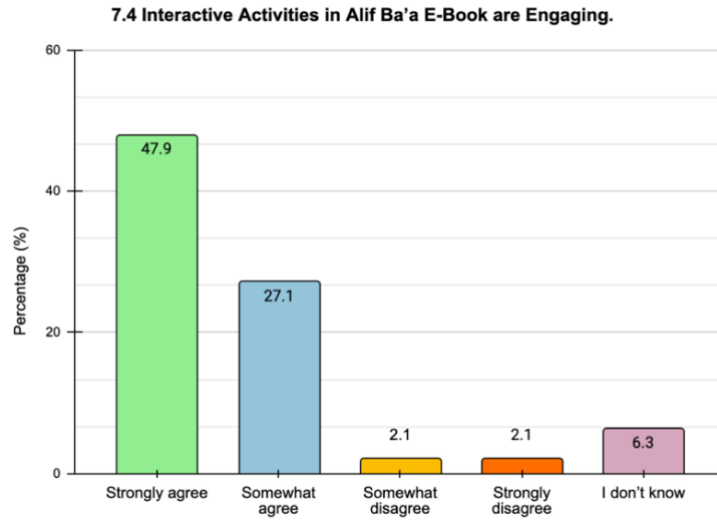


Figure 85: Interactive Activities are Engaging

Figure 86 shows that the responses regarding overall satisfaction with the interactivity of the Alif Ba'a e-book showed a strong positive perception. A majority, 54.2% (n=26), strongly agreed, while 25.0% (n=12) somewhat agreed, resulting in a combined agreement of 79.2%. A very small proportion, 2.1% (n=1) each, somewhat disagreed, strongly disagreed, or selected “I don't know”, indicating minimal dissatisfaction or uncertainty. These findings highlighted that the interactivity of the e-book was a well-received feature among most participants, contributing to its overall effectiveness and appeal.

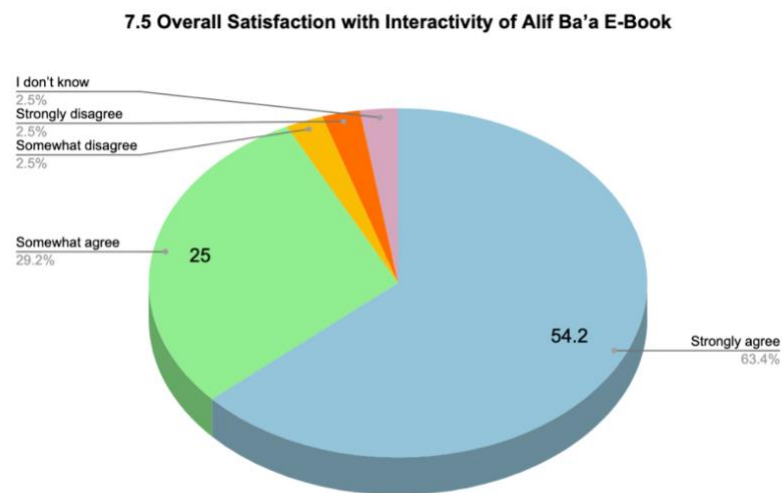


Figure 86: Overall Satisfaction with Interactivity of the E-book

6.7.2 Teachers' Data Analysis Results

This section presents an analysis of university teachers' perceptions regarding the Alif Ba'a e-book, a digital resource designed to facilitate the teaching and learning of the Arabic alphabet. Drawing on survey responses from instructors at various international institutions, the analysis examines key dimensions of the e-book's effectiveness, including its PU, PEOU, convenience, compatibility with existing teaching environments, media richness, interactivity, and overall intentions to use. The goal is to provide an evaluation of the e-book's strengths and areas for potential improvement.

6.7.2.1 Perceived Usefulness of the Alif Ba'a E-Book

The survey responses from university teachers, as shown in Figure 87, revealed a broadly positive evaluation of the Alif Ba'a e-book's usefulness in facilitating the teaching and learning of Arabic alphabet skills. The data indicated that the e-book was widely regarded as effective, particularly in foundational language domains.

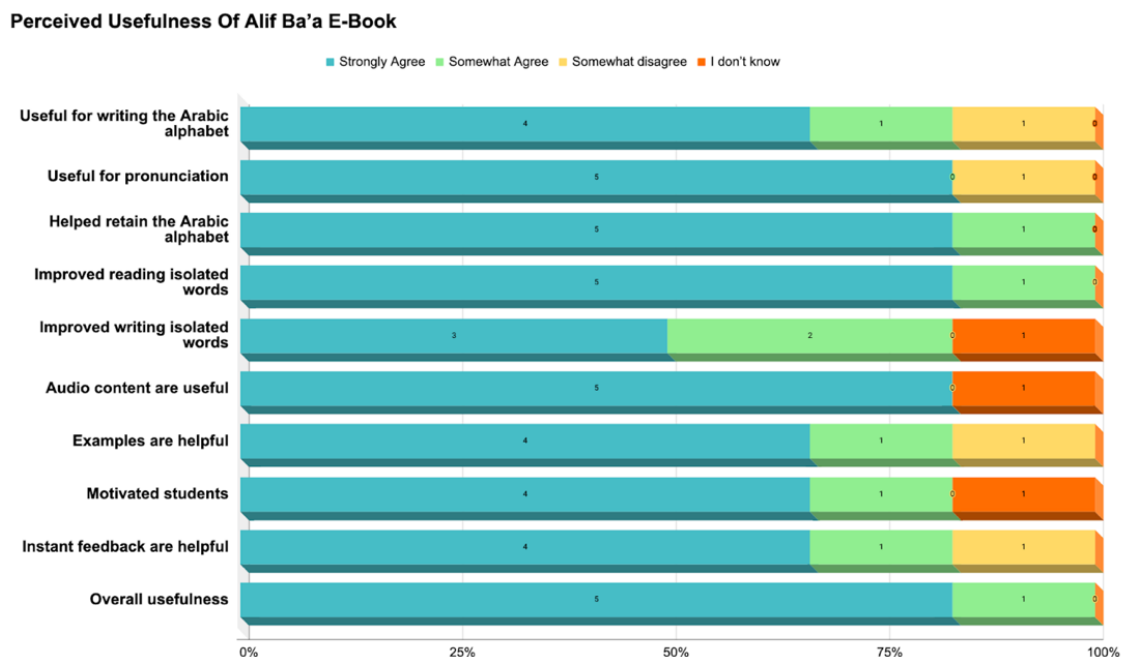


Figure 87: Perceived Usefulness of the E-Book

A clear majority of respondents (66.7%) “Strongly Agree” that the e-book was useful for teaching students how to write the Arabic alphabet, while one instructor each (16.7%) selected “Somewhat Agree” and “Somewhat Disagree.” This distribution suggested a strong majority in favour of the e-book’s instructional value, albeit with minimal dissent. The PU was even more pronounced in the domains of pronunciation and alphabet retention, where 83.3% of instructors “Strongly Agree” that the e-book aided in these areas. Only one respondent, in each case, indicated moderate or mild disagreement or uncertainty, highlighting an overwhelmingly positive response.

The e-book was also credited with enhancing students’ abilities to read isolated Arabic words, with 83.3% “Strongly Agree” and 16.7% “Somewhat Agree”. This reflected strong confidence in the e-book’s impact on early reading skills. In contrast, when it came to improving students’ abilities to write isolated words, responses were slightly more varied: 50% “Strongly Agree”, 33.3% “Somewhat Agree”, and 16.7% responded “I don’t know”. This spread might indicate that some instructors had reservations about the e-book’s writing activities or that such skills required additional support.

Audio content was another notable strength, as 83.3% “Strongly Agree” with its usefulness, and only one respondent expressed uncertainty. Features such as examples, motivation, and instant feedback were also positively received, with most instructors expressing strong agreement. However, minor proportions selected “Somewhat Agree”, “Somewhat Disagree”, or “I don’t know”, indicating some diversity in individual experiences or teaching contexts.

Overall, the survey results demonstrated a wide majority regarding the Alif Ba’a e-book’s utility, with 83.3% “Strongly Agree” and the remainder “Somewhat Agree” on its overall usefulness. Collectively, these findings confirmed the e-book’s effectiveness in supporting Arabic alphabet instruction, while also highlighting areas, particularly in writing isolated words, where further development might be warranted.

6.7.2.2 Ease of Use of the Alif Ba’a E-Book

Survey responses from university instructors (shown in Figure 88) indicated a highly favourable assessment of the Alif Ba’a e-book’s ease of use, with positive ratings across all

dimensions. Most participants “Strongly Agree” that the layout was intuitive and facilitated usability, while others “Somewhat Agree,” indicating a well-structured and good accessibility. Teachers reported that the instructions were clear and easy for students to follow, enhancing the e-book’s utility for independent and guided learning. All respondents “Strongly Agree” that the navigation was logical and user-friendly, demonstrating a consensus on the seamless interaction for both teachers and students.

Accessibility was a key strength, with most instructors reporting that students easily accessed the e-book on their devices. A large majority (83.3%) “Strongly Agree” that completing assignments and navigating activities were straightforward. Instructors also found the examples in the e-book helpful, and assigning homework through it was seen as easy, highlighting the platform’s flexibility for both in-class and at-home learning. These positive ratings showed the e-book’s effectiveness in minimising technological barriers and integrating smoothly into classroom practice.

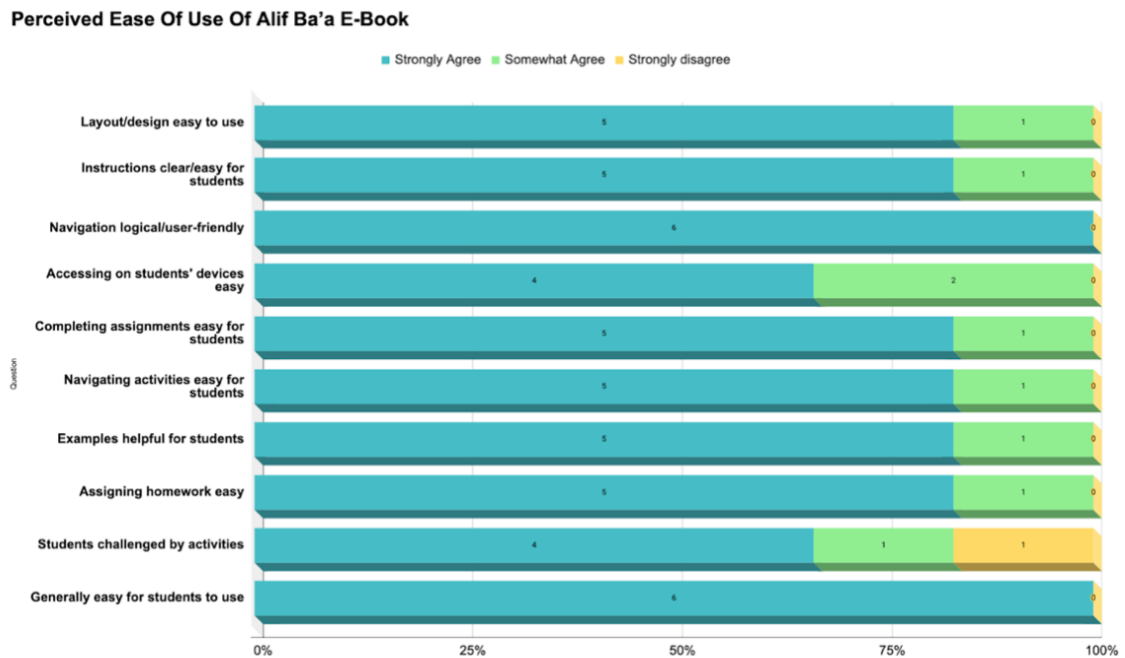


Figure 88: Perceived Ease of Use of the E-Book

Regarding student challenge, two-thirds of respondents “Strongly Agree” that the interactive activities appropriately challenged students, while one instructor each selected “Somewhat Agree” and “Strongly Disagree.” This minor divergence might reflect variations in classroom

context or learner ability, indicating a possible area for further investigation or differentiation. Importantly, all participants “Strongly Agree” that, in general, the e-book was easy for students to use, underscoring its overall accessibility and effectiveness.

Collectively, these results highlighted a wide consensus among the university teachers regarding the user-friendliness and pedagogical utility of the Alif Ba’a e-book, making it a valuable tool for digital Arabic language instruction.

6.7.2.3 Convenience of Alif Ba’a E-Book

The survey data, as shown in Figure 89, revealed a strong endorsement of the Alif Ba’a e-book’s convenience in supporting Arabic alphabet instruction among university teachers. Most respondents (83.3%) “Strongly Agree” that the e-book made it easier to integrate technology into their teaching and that it saved both time and effort, while one participant in each case indicated uncertainty by selecting “I don’t know”.

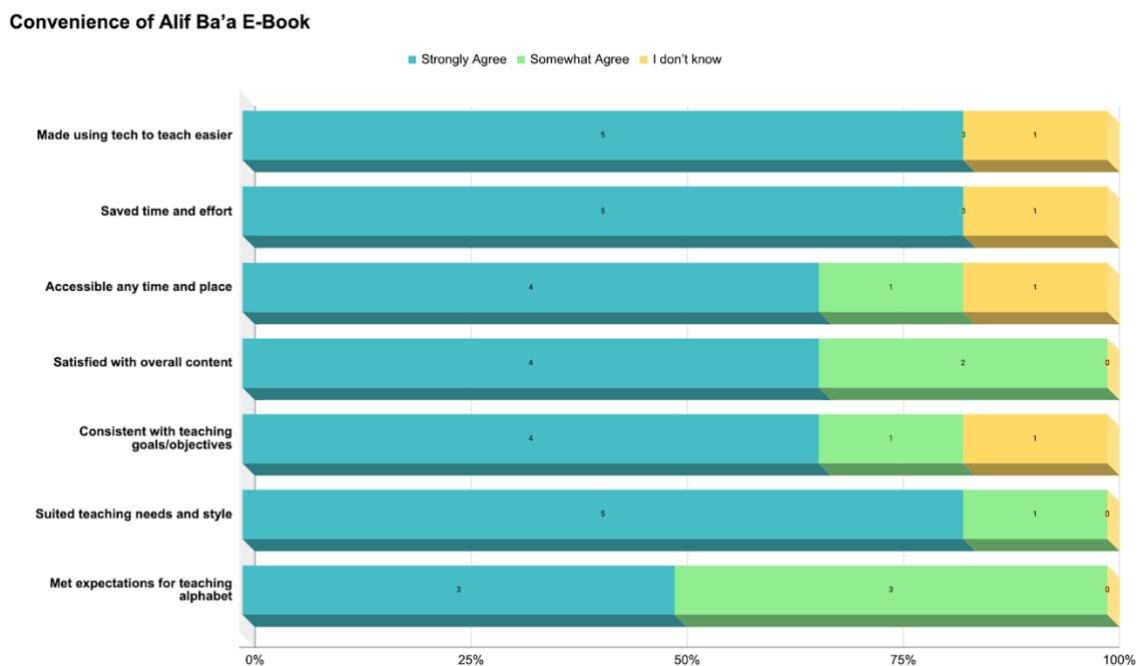


Figure 89: Convenience of the E-Book

These results underscored the e-book’s perceived efficiency and its potential to streamline instructional practices, making it an attractive tool for educators managing multiple demands

in the classroom.

When considering accessibility, two-thirds of instructors “Strongly Agree” that the e-book was available at any time and place, with the remainder “Somewhat Agreeing” or expressing uncertainty. Overall satisfaction with the content was high: 66.7% “Strongly Agree” and 33.3% “Somewhat Agree”. Similarly, A majority affirmed that the e-book aligned with their teaching goals and needs. However, a small proportion expressed moderate agreement or uncertainty, implying occasional mismatches with specific teaching contexts or preferences. Concerning meeting expectations for teaching the Arabic alphabet, responses were evenly split between “Strongly Agree” and “Somewhat Agree”, indicating general but not universal satisfaction. Taken together, these findings indicated the Alif Ba’a e-book’s success as a convenient, efficient and adaptable platform for Arabic instruction while pointing to opportunities for refinement to better meet the diverse needs and expectations of university teachers. The strong agreement across most areas indicated a positive impact of the e-book on instructional practice, though moderate ratings and uncertainties highlighted potential for improvement.

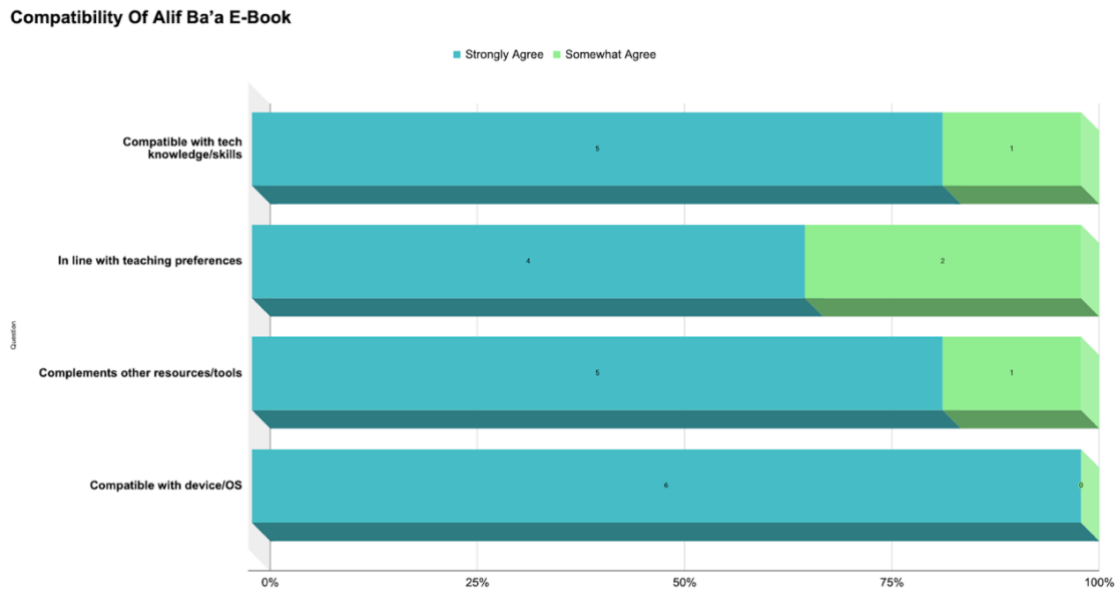
6.7.2.4 Compatibility Of Alif Ba’a E-Book

The survey findings (shown in Figure 90) indicated that university teachers perceived the Alif Ba’a e-book as highly compatible with both their technological and pedagogical environments. A significant majority (83.3%) “Strongly Agree” that the e-book aligned well with their technological skills and was effective in complementing other teaching resources, while the remainder “Somewhat Agree”, highlighting wide satisfaction with its integration capabilities.

When considering pedagogical fit, 66.7% “Strongly Agree” that the e-book was in line with their teaching preferences, with the rest stating “Somewhat Agree”. This balance suggested the resource accommodated a range of instructional approaches and was adaptable to individual teaching approaches, thereby increasing its practical relevance for diverse classrooms. All respondents (100%) “Strongly Agree” that the e-book was compatible with their devices, indicating no technical barriers hindered use. This underscores the e-book’s effective integration into university-level Arabic instruction as a user-friendly educational

tool.

Figure 90: Compatibility of the E-Book



6.7.2.5 Media Richness of Alif Ba'a E-Book

The survey results (shown in Figure 91) revealed that university teachers rated the Alif Ba'a e-book's media richness highly. Two-thirds "Strongly Agree" that the media resources, such as visual/audio aids, effectively enhance the learning experience. Only one participant "Somewhat Agrees," and another chose "I don't know." The e-book's visual design was especially praised, with 83.3% "Strongly Agreeing" on its appeal and effectiveness. Additionally, two-thirds "Strongly Agree" that the user interface is student-friendly, reflecting overall satisfaction with its accessibility and navigation.

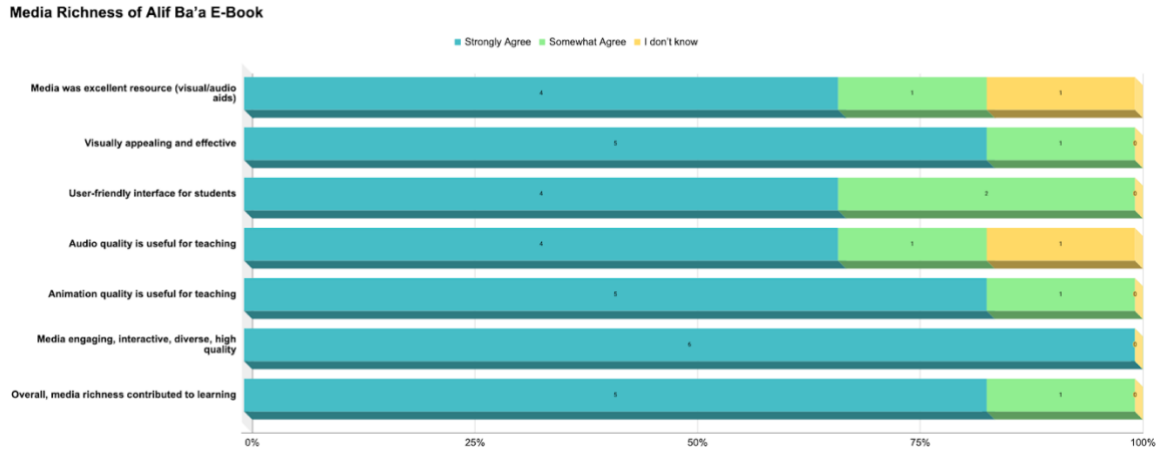


Figure 91: Media Richness of the E-Book

Audio and animation quality were likewise rated highly, though with minor variation; two-thirds of instructors “Strongly Agree” that audio and animation quality were useful for teaching, one respondent “Somewhat Agrees”, and one expressed uncertainty about the audio’s usefulness. Thus, while most viewed the media features as robust and pedagogically beneficial, a small minority reported occasional limitations or context-dependent variability in PU. Notably, all participants (100%) “Strongly Agree” that the e-book’s media was engaging, interactive, diverse, and of high quality, and that this media richness aided learning. This unanimous endorsement underscored the importance of well-integrated multimedia: the Alif Ba’a e-book’s media features were central to its effectiveness, meeting or exceeding teacher expectations for engagement and varied learning needs.

6.7.2.6 Interactivity of Alif Ba’a E-Book

The survey results (shown in Figure 92) revealed unanimous approval among the university teachers regarding the interactivity of the Alif Ba’a e-book. All respondents “Strongly Agree” that the interactive activities within both the “Practice” and “Produce” sections were highly effective for supporting the acquisition and reinforcement of the Arabic alphabet, and every respondent “Strongly Agree[d]” that the overall interactivity of the e-book represented a central strength of the resource. This consensus highlighted the perceived pedagogical value of well-designed digital exercises in language learning.

Participants also universally reported that using the interactive activities was enjoyable, indicating that the e-book fostered a positive and motivating learning environment. Engagement was a critical factor in language acquisition, and the complete agreement among instructors about the engaging nature of these activities attested to the quality and relevance of the e-book’s interactive components and its effectiveness in meeting the interactive needs of both students and teachers in contemporary Arabic instruction.

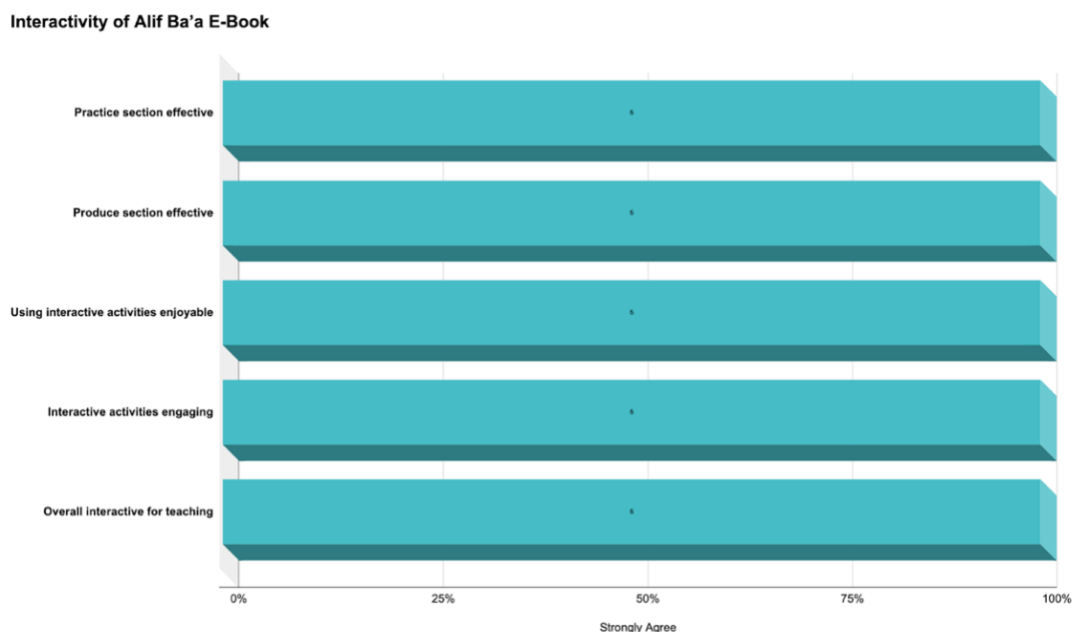


Figure 92: Interactivity of the E-Book

6.7.2.7 Intentions to Use Alif Ba’a E-Book

The survey results (shown in Figure 93) demonstrated a notably positive orientation among university teachers towards the ongoing use of the Alif Ba’a e-book in Arabic language instruction. Two-thirds of respondents (66.7%) “Strongly Agree” and the remaining third (33.3%) “Somewhat Agree” that they intended to use e-books for learning Arabic in the future, indicating broad acceptance and enthusiasm for digital learning resources. Similarly, the recommendation rate for the e-book was high, with 83.3% of teachers “Strongly Agreeing” that they would recommend the Alif Ba’a e-book to colleagues. In comparison, one respondent (16.7%) “Somewhat Agreed.” This reflected a strong collective endorsement of the resource’s perceived quality and effectiveness within the professional community.

Finally, perceptions of the e-book’s value in teaching were overwhelmingly positive, as five out of six instructors “Strongly Agree” and one “Somewhat Agree” that the e-book was an asset for Arabic language instruction. Together, these results underscored a positive intention not only to adopt the Alif Ba’a e-book in future practice but also to advocate its use to others, highlighting its recognised value as a teaching tool.

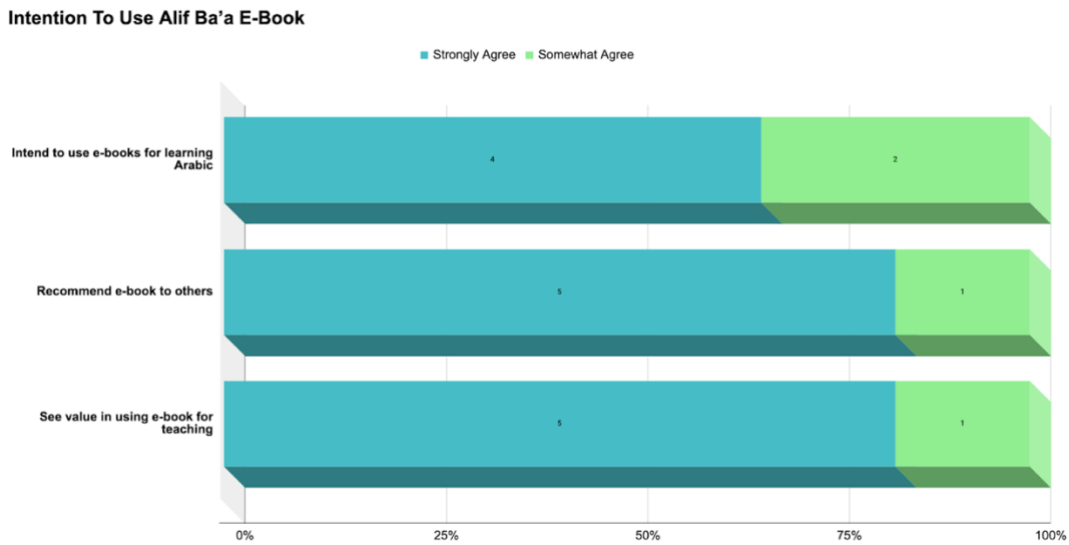


Figure 93: Intention to Use Alif Ba’a E-Book

Chapter 7: Discussion

7.1 Introduction

This chapter synthesises findings from the DBR study evaluating the pedagogical and technological effectiveness of Alif Ba'a, an interactive e-book for elementary AFL learners of the Arabic writing system. Employing a sequential mixed-methods design across three DBR cycles and guided by Passey's LEF (2011), Davis's TAM (1989), the PPP Approach (Widyantoro, 2019) and Bozkurt and Bozkaya's IEEC (2015), it integrates teacher and student qualitative and quantitative data. The chapter revisits the challenges that motivated Alif Ba'a's development, analyses how its interactive features responded, and evaluates PU and usability. Outcomes are organised and interpreted in relation to each research question across DBR cycles. Furthermore, it triangulates empirical results with the literature to outline Alif Ba'a's contributions, situates them within TELL, and underscores the need to align innovation with pedagogy. It concludes with implications for instructional design, research, and AFL learning.

7.2 Cycle One: RQ1 – Challenges Encountered in Teaching the Arabic Writing System

The first cycle of this DBR study addressed RQ1: "What challenges are encountered in teaching the Arabic writing system?" Drawing on insights from exploratory focus group discussions with experienced AFL educators, the analysis yielded two principal and interconnected themes: *Technology Overwhelms Teachers and Students* and *Online Arabic Alphabet Teaching Issues*, both of which illuminate the complex realities of teaching the Arabic writing system in online contexts.

7.2.1 Technology Overwhelms Teachers and Students

This theme highlighted the systemic barriers to integrating technology in Arabic writing instruction, particularly with non-Latin scripts. Teachers faced significant challenges during the sudden shift to online instruction, as noted by Goudarzi et al. (2023), Li (2022), and Moustakas and Robrade (2022). Teachers in focus groups noted that the lack of kinaesthetic modelling for letter formation—a critical aspect of mastering Arabic script—was disruptive,

as digital platforms often could not replicate the tactile nature of handwriting practice. This resulted in reduced instructional fidelity as noted by Alfayez (2022) and Back et al. (2021). In this study, focus-group teachers at that initial stage reported that the rapid transition, often with inadequate support, increased student disorientation and hindered their ability to model and observe correct writing techniques, such as directionality and stroke order (Li, 2022).

These observations reinforce Sweller's (1988) cognitive framework, which emphasises avoiding cognitive overload. Although literature addresses load reduction through well-designed digital tools (Mayer, 2005), the current findings indicate that generic e-learning platforms are ill-equipped for Arabic-script demands, echoing concerns raised by Alfayez (2022). The transition, therefore, amplified cognitive load for AFL teachers and students and exposed a gap in AFL-specific digital pedagogy, assessment and practical implementation.

Teachers described the overwhelming nature of mandatory workshops and training programmes for online teaching. Although intended to enhance digital literacy, participants experienced cognitive and temporal overload when workshops were not tailored to their needs or contexts, as observed by Trust and Whalen (2020). This aligns with critiques of one-size-fits-all professional development and contrasts with Bozkurt and Bozkaya's (2015) emphasis on user-centred design requiring context-specific and hands-on training. The findings also challenge the TAM, specifically PEOU (Davis, 1989), as technical upskilling increased perceived effort and, in many cases, eroded pedagogical efficacy, as discussed by Taherdoost (2018) and Smeda (2017). The absence of Arabic-literate technical guidance worsened anxiety, highlighting the limits of generic training for teachers working with non-Latin scripts.

Technical difficulties—unstable Internet connectivity, device incompatibility, and platform limitations—were major barriers to effective teaching and learning, aligning with Alfayez's (2022) findings. These issues disrupted synchronous lessons, delayed feedback cycles, and heightened inequities among students with differential access to technology and infrastructure, as noted by Al-Wabil et al. (2006), Doush et al. (2014), Jin (2014), and Lai and Ulhas (2012). Particularly in regions with unreliable infrastructure, such barriers undermined real-time correction of letter shaping and other tasks requiring immediate

feedback.

7.2.2 Online Arabic Alphabet Teaching Issues

The digitisation of Arabic writing instruction exposed script-specific challenges that digital environments inadequately addressed. Teachers could not monitor stroke order, direction, or diacritic placement in real time, leading to fossilised errors. This contrasted with the interactive e-books proposed by McTigue and Slough (2010), which facilitated acceptable writing practices. These issues arise from Arabic's morphological complexity: letters change form (initial, medial, final) and require spatial adjustments, as described by Wiley and Rapp (2019). Digital tools lacking script-sensitive handwriting recognition failed to replicate instructors' diagnostic role for errors such as misplaced dots or vowel markers, confirming Rao's (2003) caution about technological solutions without linguistic adaptation.

This study reaffirms the challenges teachers face in monitoring the pronunciation of Arabic phonemes, particularly those absent from learners' native languages. The online environment—limited visibility of mouth movements, suboptimal audio, and asynchronous communication—hindered corrective feedback, as noted by Benaïda (2014) and El-Sabagh and Hamed (2020).

The current study findings further highlighted the excessive time demands associated with providing individualised feedback on writing and pronunciation in online learning environments. Manual review—requiring uploads of handwriting images or screenshots—increased workload, tripling assessment time and undermining efficiencies, as also reported by Saëli and Rahmati (2023).

Maintaining engagement during online sessions was a concern, as the absence of interactive, gamified, or collaborative activities in some digital tools fostered disengagement and low motivation, as noted by Dahlan et al. (2024). Evidence showed that interactivity, multimedia, and authentic communication enhance engagement, whereas passive, text-heavy tasks reduce participation for younger or less motivated learners, as discussed by Yorganci (2022) and Hwang and Wang (2018). For AFL, navigating unfamiliar interfaces while learning letter differentiation increased cognitive load, underscoring the need for metacognitive alignment

between digital interaction and script mastery.

7.3 Cycle One: RQ2 – Ideal Digital Tools for Teaching the Arabic Writing System

The second research question in Cycle 1 of this DBR study asked: “What is your dream digital tool you wish to have to teach the Arabic writing system?” It elicited practical and pedagogical aspirations from experienced AFL teachers. Two themes were identified: *Design Preferences of the e-book* (interactivity, real-time feedback, customisability) and *Pedagogical Preferences* (general suggestions and activity types). The discussion synthesises these perspectives with relevant literature to interpret their significance and the distinctiveness of this study’s findings.

A consistent theme was the centrality of interactivity. Teachers stressed that the tool should promote active engagement by incorporating interactive writing activities, visual/audio aids, and performance monitoring. These preferences align with studies that show multimedia-rich, interactive e-books enhance engagement and learning (El-Sabagh, 2021; Zhang et al., 2020). The importance of interactivity is also highlighted in the IEEC by Bozkurt and Bozkaya (2015). Participants noted that interactive writing tools, especially those with step-by-step tracing, enhance the acquisition of Arabic script by compensating for the lack of physical guidance in online settings. This aligns with research demonstrating that digital handwriting practice with instant feedback effectively supports correct letter formation (Dahlan et al., 2024).

Real-time feedback was another prominent preference. Teachers noted that immediate correction and guidance, characteristic of F2F instruction (yet hard to replicate online), were vital for Arabic script acquisition. The desire for live annotation tools, instant messaging, and integrated feedback systems in digital platforms mirrored the literature’s emphasis on instant electronic feedback as a driver of learning efficiency, student satisfaction, and engagement (El-Seoud et al., 2016; Ross et al., 2018; Zhang et al., 2020).

Customisability—tailoring content and pathways to individual needs—was also identified as critical. Teachers highlighted adaptive features, including flexible sequencing, custom feedback modes, and supplementary resources (e.g., digital worksheets and quizzes). This

preference corresponded with research advocating adaptive environments that enable self-direction and accommodate diverse proficiency levels. Flexible learning paths and options for independent study are especially pertinent in AFL contexts. Bozkurt and Bozkaya (2015) identify customisation and autonomy, while Passey (2011) similarly supports learner autonomy and differentiated instruction through the LEF, reinforcing the relevance of customisability to effective e-book design.

Teachers also emphasised varied activity types—guessing games, mechanical drills, sound-embedded flashcards, and voice recordings with feedback. These preferences were consistent with research on multimedia integration and cognitive load, which supported multimodal input to sustain interest and enhance outcomes (Widyantoro, 2019).

7.3.1 Conclusion

The initial DBR project phase found that teaching the Arabic writing system online faced challenges. Aligning with the literature, findings highlighted the need for innovative approaches in Arabic education. Teachers emphasised the importance of digital platforms that provided real-time, multimodal feedback and handwriting demonstrations. In response, the Alif Ba’a e-book was enhanced before the second cycle, incorporating interactivity, customisation, and instant feedback, with a focus on user experience over classroom replication. Its implementation informed the analysis of RQs 3-6, particularly regarding learner engagement, differentiated instruction, and language acquisition outcomes.

7.4 Cycle Two: RQ3 – AFL Teachers’ Perceptions of the Interactive E-Book

This section discusses the findings from Cycle 2 of the DBR, with a specific focus on RQ3: “What are AFL teachers’ perceptions of using the interactive e-book to teach the Arabic writing system?” The data obtained from individual semi-structured interviews with AFL teachers were interpreted through the lens of the TAM (Davis, 1989; Davis et al., 1989) and situated within the broader body of literature concerning the adoption of digital tools in language education. The analysis is organised under Theme 1: Teachers’ BI, which includes PU and PEOU.

7.4.1 Teachers' Behavioural Intentions

A prominent theme to emerge was teachers' BI to adopt the interactive e-book, largely due to its PU for beginner and autonomous learners and its ease of use, intuitive interface, and multimedia features. This matched Tsai's (2012) definition of BI as an individual's willingness to use information technologies in the future and aligned with the TAM's core constructs: PU and PEOU (Davis, 1989). These factors were pivotal in teachers' acceptance of the Alif Ba'a e-book, increasing their intention to integrate it into teaching.

7.4.1.1 Perceived Usefulness

Teachers highlighted the e-book's effectiveness for Arabic alphabet instruction, particularly through its multimedia elements, which, as noted by Alhammad and Ku (2016), enhance clarity in phonetics, particularly for unfamiliar sounds. This aligned with Trigui et al.'s (2012) findings on improved comprehension and retention in language learning. In addition, interactive exercises like drag-and-drop, letter matching and minimal-pair were praised for promoting autonomous practice, aligning with Letchumanan and Tarmizi's (2011) claim that interactive features improve script acquisition. These observations suggested that the e-book's design aligned with effective teaching strategies and curricular goals. Participant 4 noted its cost-effectiveness compared to traditional textbooks, supporting the TAM's idea that PU drives BI (Davis et al., 1989).

However, contradictions emerged in writing instruction. While tracing exercises with instant feedback were praised, teachers noted limits in simulating connected word writing—a recognised difficulty for beginners (P5 and P6). This echoed Trigui et al.'s (2012) critique of e-books' privileging discrete skills over contextualised application, revealing misalignment with the cognitive demands of Arabic cursive script. This partial realisation of PU highlighted a design constraint addressed before Cycle 3. Limitations were also reported in real-time monitoring and feedback. Participant 5 noted the inability to observe students' writing during online sessions, mirroring Alhammad (2017), who argued that the absence of tactile feedback and real-time interaction can reduce the effectiveness of digital tools in e-learning. Accordingly, an interactive traceable exercise was included in each unit before Cycle 3.

7.4.1.2 Perceived Ease of Use

Evaluations of ease of use are centred on interface design and technical functionality. Positive feedback highlighted the intuitive organisation of the table of contents and the dual-section layout, with several teachers drawing parallels to the structure of a traditional textbook (P2), which corresponded with Bozkurt and Bozkaya's (2015) emphasis on consistency in interface design. Features such as bookmarking and note-taking were appreciated for supporting lesson customisation, mirroring the findings of Alhammad and Ku (2016) and Kamarulzaman and Shaari (2015) that customisable digital tools enhance instructional flexibility. Additionally, participants described the e-book as user-friendly and accessible, noting it did not require additional technical skills (P1), consistent with the TAM's construct of PEOU (Davis, 1989). The clarity and organisation of the e-book's layout were repeatedly noted, with P2 remarking on the ease of locating specific letters due to its well-structured design, in line with Lai and Ulhas (2012), who found that intuitive navigation encourages acceptance of e-learning tools.

However, barriers to PEOU included technical issues with cross-platform compatibility, such as GIF animations lagging on tablets and writing exercises freezing on older laptops. These challenges reflected Boudhief et al.'s (2014) arguments about inconsistent device performance undermining the adoption of e-books in classrooms with varying resources. Concerns were also raised regarding the complexity of advanced features, with time-constrained teachers finding it challenging to master functions like exporting notes or assigning quizzes. Such observations accorded with Ngafeeson's (2011) assertion that technical complexity can significantly reduce PEOU, especially where professional development is limited. These challenges were addressed in the final stage of e-book development before Cycle 3.

7.4.2 Conclusion

Findings from Cycle 2 demonstrated that AFL teachers' BI to adopt the Alif Ba'a interactive e-book was shaped by the interplay of its pedagogical value (PU) and operational practicality (PEOU), as articulated in the TAM (Davis, 1989). The e-book's multimedia features, intuitive interface, and curricular alignment were key strengths, enhancing usefulness.

However, cross-platform compatibility issues and the absence of real-time feedback constrained ease of use, highlighting tensions between innovation and practical demands. These findings informed refinements before Cycle 3, reinforcing the necessity of aligning digital tools with instructional requirements. The study emphasised the importance of user experience design and the need for further research on e-books for advanced learners, underlining the value of feedback-driven development for effective learning.

7.5 Cycle 2: RQ4 – Teachers’ Perceptions of Challenges Related to PEOU and PU of the AFL Interactive Mobile E-Book

This section addresses RQ4: “What challenges do teachers encounter with the PU and PEOU of the AFL interactive mobile e-book?” Drawing on a TA of individual interviews with AFL teachers, the findings shed light on challenges teachers faced when integrating e-books into their classrooms. Framed by the TAM (Davis, 1989), which foregrounds PU and PEOU as pivotal to technology acceptance, these challenges were organised into three principal themes: *Pedagogical Problems*, *Technology Problems*, and *Multimedia Problems*, each with specific sub-themes.

7.5.1 Pedagogical Problems

Pedagogical problems encompassed issues with the e-book’s content and instructional design that affected educational effectiveness. Teachers’ concerns centred on language activities, feedback mechanisms, and clarity of activity instructions, each of which directly influenced PU and PEOU in AFL classrooms.

Teachers noted that many language learning activities were overly simplistic, resulting in low cognitive demand. This diminished deeper engagement and skill development, mirroring literature indicating that basic digital exercises failed to sustain motivation or progression (Dahlan et al., 2024; Zhang et al., 2020), and aligned with cognitive load theory (Sweller, 1988), where tasks below an optimal challenge do not elicit the mental effort required for meaningful learning outcomes (Sweller, 1988).

In line with Bozkurt and Bozkaya (2015), who argue that meaningful, goal-oriented tasks enhance PU, teachers found that the e-book’s content lacked thematic vocabulary or context-

rich examples, which were fundamental for retention. This contrasted with best practices advocating for coherent, well-structured content (Alsofyani, 2019; Bozkurt & Bozkaya, 2015; Korat & Falk, 2017). Although the e-book's structure followed the PPP Approach, the "Practice" and "Production" phases did not sufficiently support differentiated learning or higher-order cognitive skills, suggesting a need for varying difficulty levels to address diverse learners' needs.

The absence of instant, formative feedback in exercises was identified as a pressing concern. Teachers emphasised that real-time, automated responses were vital for fostering learner autonomy and self-correction, a point echoed in the literature on interactive e-learning (El-Seoud et al., 2016; Rutz & Ehrlich, 2016). Without timely feedback, persistent errors might go uncorrected, and students might feel unsupported, thus undermining the tool's PU. This deficiency negatively affected both PEOU and PU: teachers' intervention workloads increased, reducing ease of use, while students' abilities to monitor their progress diminished—contrary to the importance of feedback in self-regulated learning (Smeda, 2017; Trigui et al., 2012; Zhang et al., 2020).

Frequent inconsistencies and ambiguities in activity instructions directly impacted PEOU. Unclear guidance increased cognitive load and caused frustration, reflecting Sweller (1988) and aligning with Bozkurt and Bozkaya's (2015) usability guidelines that prioritise interface clarity and user autonomy. Similarly, the absence of standardised instructional scaffolding was inconsistent with Hong and Yu (2018), who recommend clear task structuring to prevent disengagement. The lack of onboarding materials or a user manual compounded these issues, especially for novice users, who encountered heightened usability issues, which aligned with Hong and Yu (2018). Thus, enhancing instructional scaffolding through more explicit guidance and user support was vital for improving PEOU.

In response to these pedagogical challenges—overly simplistic activities, absence of thematic vocabulary, insufficient feedback, and unclear instructions—the e-book was refined before Cycle 3. The refinement phase increased cognitive demand, introduced varied difficulty levels, and organised vocabulary thematically. Real-time feedback and standardised instructional scaffolding, including a user guide, were implemented. These

modifications were informed by teacher feedback and best practices, ensuring systematic attention to the issues impacting PU and PEOU.

7.5.2 Technology Problems

Beyond pedagogical challenges, teachers reported technical issues with the e-book's design and functionality, including problems with its interface and underlying platform, with sub-themes emerging around interface design, accessibility, and system reliability. These issues disrupted classroom implementation, thereby reducing PEOU and indirectly diminishing PU.

Teachers acknowledged the e-book's interface as user-friendly and accessible, consistent with the TAM construct of PEOU. This matched Ryś et al. (2009), who identified intuitive design as reducing cognitive load and enhancing usability in e-book adoption. However, technical barriers challenged perceived reliability, a factor associated with reduced user satisfaction (Alhammad, 2017). While clarity of the interface was praised, functional limitations were reported, exposing the gap between design intentions and user experiences in educational technology tools (Nishat & Islam, 2015).

Language-related challenges were central to critiques of the e-book's PU. English-based instructions lacked sufficient detail, causing confusion for learners, which echoed Chou's (2015) observation that clear and culturally appropriate instructions were necessary in multilingual environments. The absence of explicit guidance in the e-book's design contradicted best practices in educational technology, which recommend scaffolding through contextualised prompts (Alsofyani, 2019). Similarly, the speed of multimedia elements was problematic; rapid demonstrations hindered comprehension, aligning with Mayer's (2005) emphasis on pacing in multimedia learning.

Some activities were insufficiently adapted to Arabic linguistic norms, limiting their educational value, consistent with research on the necessity of culturally and linguistically responsive design in educational technologies (Alhammad, 2017; Ryś et al., 2009).

A central issue was the use of left-to-right interactive formats, such as crossword puzzles and Hangman, incompatible with Arabic's right-to-left orthography. Such inconsistencies may foster cognitive dissonance, contradicting the TAM's emphasis on usability and relevance

(Davis, 1989). This critique corresponded to Widyantoro (2019), who suggested misaligned content diminishes user engagement and perceived relevance.

Certain non-essential features, such as photo-taking capabilities, were described as impractical and detrimental to PEOU, without pedagogical benefit, in contradiction to the TAM's advocacy for streamlined, purpose-driven design (Davis, 1989). The literature cautioned that extraneous functionalities could overwhelm users (Alhammad, 2017; Nishat & Islam, 2015), emphasising the importance of functional alignment with users' cognitive and instructional needs.

7.5.3 E-book Multimedia Problems

Multimedia challenges involved audio-visual limitations and inadequate interactive media integration, impacting both PU and PEOU. Sub-themes included the absence of audio-based activities, offline access constraints, and inconsistent multimedia quality. These factors undermined expected learning gains (PU) and user convenience (PEOU).

The absence of integrated audio pronunciation exercises was a significant limitation; auditory input is critical to language acquisition, particularly given Arabic's phonetic complexity, and its omission reduced PU. The limited multimodal experience contradicted Mayer's (2005) Cognitive Theory of Multimedia Learning; Erradi et al. (2012) and Trigui et al. (2012) showed that audio integration strengthens sound-symbol connections and pronunciation. Audio features like clickable sound icons and listening quizzes would have improved ease of use for independent study and aligned better with AFL pedagogy, increasing PU.

Reliance on an Internet connection limited functionality in unreliable contexts, reducing PEOU and PU by undermining consistent practice and "anytime, anywhere" learning. This was supported by findings that offline capability is a key determinant of adoption (Al-Thani et al., 2019; Doush et al., 2014) and that multi-platform support was critical (Bozkurt & Bozkaya, 2015). Ensuring downloadable, synchronised content would enhance PU and PEOU through equitable access.

Feedback on multimedia quality was mixed. While letter-writing animations were praised, the lack of interactivity and user control reduced PEOU, contrary to user-centred design

principles (Possatti et al., 2018). Poor integration of multimedia with the curriculum risked cognitive overload or confusion (Bozkurt & Bozkaya, 2015; Mayer, 2005). AFL multimedia needs, such as differentiating letter names and sounds, remained unmet. Effective implementation required high-quality, user-controlled, and pedagogically integrated multimedia (Benaida, 2014; Bozkurt & Bozkaya, 2015).

7.5.4 Conclusion

Cycle 2 revealed challenges in pedagogy, technology, and multimedia affecting teachers' perceptions of the AFL interactive e-book. Simplistic activities, unclear instructions, insufficient feedback, technical inconsistencies, and limited multimedia integration diminished its value. Consequently, activities were redesigned to meet higher cognitive demands, feedback was enhanced, instructions were standardised, technical reliability was improved, and multimedia features—including audio and offline access—were integrated. These enhancements strengthened the e-book, better aligning it with pedagogical and technological needs for more effective and equitable language learning.

7.6 Cycle Two: RQ5 – AFL Students' Perceptions of the Interactive E-Book

This section critically examines AFL students' perceptions of the interactive e-book intervention for learning the Arabic writing system, focusing on key findings from Cycle 2 and addressing RQ5: “What are the perceptions of AFL students regarding the use of the AFL interactive e-book for learning the Arabic writing system?” The analysis was grounded in the TAM (Davis, 1989), which provided the theoretical lens for interpreting students' responses in PU, PEOU, and BI. The discussion is structured around two main themes—*General Perceptions* and *Students' BI*—each broken down into relevant sub-themes.

7.6.1 General Perceptions

Students reported positive perceptions of the e-book's compatibility with mobile devices, highlighting its convenience, accessibility and smooth performance. These findings aligned with MALL literature on on-the-go learning afforded by mobile technology (Alhammad, 2017; Rao, 2003; Zhang, Almeraj, & Alhammad, 2020). PDF conversion and offline access further enhanced engagement, reflecting universal design for learning principles (Al-Thani

et al., 2019; Boudhief et al., 2014; Bozkurt & Bozkaya, 2015). Students' appreciation of compatibility corresponded with Rogers' Diffusion of Innovations and Jin's (2014) finding that compatibility enhanced PU and BI, supporting e-book acceptance.

However, several students reported usability problems on smaller screens—difficulty with precise touchscreen input during writing exercises—contrasting with earlier research that found minimal mobile issues or assumed seamless interactivity (Alhammad, 2017; Rao, 2003; Yaya, 2015). This discrepancy echoed Nishat and Islam (2015) and Dalton (2014), who advocated for device-specific adaptations. Thus, although the e-book's mobile compatibility supported its PU, technical limitations on some devices indicated a need for refinement to meet learners' ergonomic and functional needs.

Students favourably evaluated the interactive quizzes for practice and self-assessment, seeing them as effective reinforcers that provided immediate feedback—consistent with literature on motivational and retention benefits in e-learning environments (El-Seoud et al., 2016; Ross et al., 2018). The quizzes' alignment with AFL course objectives and gamified features enhanced appeal and PU, corresponding to task–technology fit (Pilco, 2017) and gamification strategies in language learning (Karakoç, 2021; Yorgancı, 2022). This engagement reflected constructivist approaches where interactivity and timely feedback underpinned knowledge construction (Ellershaw & Oudshoorn, 2007; Sirkiä & Sorva, 2015), showing congruence between pedagogical theory and technological implementation.

However, students criticised quiz repetitiveness and the absence of adaptive difficulty for differing proficiencies, echoing Dalton's (2014) warning that static quiz formats may reduce long-term engagement and highlighting the tension between standardised design and personalised learning (Alhammad, 2017). Moreover, occasional technical faults—delayed submissions and session timeouts—were also noted, supporting Phadung and Dueramae's (2018) point that multimedia benefits depended on reliable operation. Çirakoğlu et al. (2022) similarly distinguished theoretical from functional interactivity, arguing for strong integration of text, images, and animations to minimise cognitive overload.

7.6.2 Students' Behavioural Intention

7.6.2.1 Perceived Usefulness

Students regarded the interactive e-book as a valuable tool for learning the Arabic writing system, citing improvements in pronunciation, writing, and reading skills. This resonated with Davis's (1989) definition of PU and echoed findings that high PU predicted adoption (Letchumanan & Tarmizi, 2011; Salloum & Shaalan, 2018). The e-book's multimedia elements (animated demonstrations and audiovisual guides) were highly valued and aligned with Mayer's (2005) multimedia learning theory and media richness (Boudhief, 2012; Wu & Chen, 2018), supporting comprehension and engagement. Students appreciated the structured lesson progression mirroring the Presentation, Practice and Production (PPP) Approach (Widyantoro, 2019); interactive writing exercises, quizzes and revision tools complemented this sequencing, enabling self-paced study and explaining the e-book's positive evaluations as an effective supplement.

7.6.2.2 Perceived Ease of Use

Students reported high PEOU, characterising the e-book as intuitive and user-friendly, consistent with Davis (1989) and studies stressing usability in technology adoption (Letchumanan & Tarmizi, 2011; Mizher & Alwreikat, 2023; Nazari & Abdekhoda, 2021). The e-book's clear layout and navigation echoed cognitive-load and usability principles (Tovstiadi et al., 2018). Features such as the interactive table of contents, search, text-highlighting, and note-taking enabled students to locate information and study efficiently. In addition, reliable cross-device performance supported optimisation and matched findings on system reliability (Alshaya & Oyaid, 2017; Lai & Ulhas, 2012). The design met expectations and promoted autonomous, self-directed learning.

However, technical issues — login errors, slow multimedia loading, and unresponsive touch gestures — occurred. These findings echoed those of Venkatesh and Davis (2000) and Smeda (2017), who emphasised that technical infrastructure and compatibility were critical to user experience. Such issues mirrored broader concerns in the literature about barriers to e-learning adoption (Alhammad, 2017), with students' frustration matching Dalton's (2014),

that combining simplicity with functionality is difficult. In line with the TAM, technical difficulties could undermine confidence and lead to discontinuation of use (Davis, 1989). Addressing them would be crucial to maintaining the high ease of use perception that students reported.

7.6.3 Conclusion

AFL students viewed the e-book positively for its convenience and multimedia features, and intuitive interface. Its alignment with the TAM and MALL literature underscored the importance of PU and PEOU in the context of technology acceptance (Davis, 1989; Jin, 2014). However, usability problems on small screens, repetitive quizzes and glitches revealed areas needing improvement, echoing Dalton (2014) and Alhammad (2017), and calling for adaptive, learner-centred design. Although it fostered autonomy and engagement, technical and ergonomic limitations curtailed its impact on handwriting and pronunciation.

The subsequent section addresses how student feedback informed refinements to the e-book prototype to better align with user expectations and pedagogical needs.

7.7 Cycle Two: RQ6 – Student Challenges in Using the AFL Interactive E-Book

This section addresses RQ6: “What challenges do students face regarding the PU and PEOU of the AFL interactive mobile e-book?” The analysis is centred on Cycle 2 findings from focus group discussions with AFL students and is organised into primary themes: *Pedagogical Problems*, *Technology Problems*, and *E-book Multimedia Problems*, with their respective sub-themes. In the following discussion, these findings are examined in relation to existing theories and research in educational technology and language learning.

7.7.1 Pedagogical Problems

A central challenge reported by students concerned the clarity and consistency of activity instructions. This finding resonated with research, as Bozkurt and Bozkaya (2015) emphasised the criticality of content and instructional clarity in evaluating interactive e-books. Similarly, the significance of clear, concise instructions for PEOU was mirrored in the arguments of Tri-Agif et al. (2016) and Alhammad and Ku (2016). These pedagogical

issues reflected a gap between the e-book's learner-centred goals and its actual execution. Constructivist and learner-centred design principles (Alhammad & Ku, 2016) emphasised well-defined tasks to support student autonomy. The PPP approach suggested that practice activities required strong scaffolding and step-by-step guidance (Widyantoro, 2019). Student confusion during practice tasks highlighted the inadequacy of the scaffolding provided.

7.7.2 Technology Problems

Students reported that interface and navigation issues affected ease of use, particularly due to unclear terminology and layout, like the confusing distinction between “Practice” and “Produce”. The absence of onboarding tutorials further compounded the challenge. These issues aligned with usability principles, where interfaces lacking self-explanation required more user effort, thereby decreasing PU and PEOU (Bozkurt & Bozkaya, 2015; Mizher & Alwreikat, 2023). Salloum and Shaalan (2018) emphasised the necessity of intuitive navigation, especially for users with varying digital literacy levels. Additionally, Tri-Agif et al. (2016) and Alhammad and Ku (2016) noted that familiar terminology and well-structured menus could reduce confusion. The mismatch between e-book labels and learner expectations highlighted a design gap, particularly for Arabic writing tasks (Alhammad, 2017).

Additional interface issues further hindered usability, as students reported that content did not fit well on their screens, reflecting poor optimisation across device sizes. These issues directly lowered PEOU, which was congruent with Jin's (2014) and Al-Wabil et al.'s (2006) emphasis on compatibility and responsiveness as critical external factors for usability. From a universal design perspective, educational technologies should function effectively across platforms and support low-end devices (Al-Wabil et al., 2006; Boudhief et al., 2014), and the e-book's shortcomings here suggested a lack of alignment with these standards.

Students encountered technical issues when accessing PDF content on mobile devices, limiting usage to desktops. The note-taking feature occasionally froze, highlighting software instability. This aligned with Lai and Ulhas's (2012) argument that device compatibility enhanced PEOU and PU. The e-book's inconsistent performance on common mobile browsers reduced its perceived compatibility.

Students faced challenges with Arabic writing input methods, as many lacked Arabic keyboards and struggled with trackpad tasks. This aligned with Al-Wabil et al.'s (2006) emphasis on the importance of designing Arabic learning tools that accommodate device constraints and input methods. The lack of a built-in Arabic keyboard complicated system use and decreased PEOU and PU (Hubona & Whisenand, 1995).

7.7.3 Multimedia Problems

Student feedback on multimedia elements was mixed. While pronunciation videos and audio clips were appreciated, the content was often deemed inadequate. Many preferred real people demonstrating pronunciation over animated illustrations. Additionally, audio clarity issues made sound blends difficult to distinguish. These findings partially aligned with the literature on media richness and its role in enhancing PU; studies suggested well-integrated multimedia could improve engagement and comprehension (El-Seoud et al., 2016). However, dissatisfaction with multimedia features showed a gap between design intent and user experience, highlighting a need to improve media richness to enhance PU and PEOU.

Salloum and Shaalan (2018) indicated that rich media could enhance PU, but poor implementation might undermine this effect. When audio-visual content was unclear or irrelevant, it diminished the educational value of e-books. Some pronunciation videos lacked clarity, as students noted, contrary to literature expectations (Erradi et al., 2012; Trigui et al., 2012). This highlighted a gap between theoretical promise and practical execution, emphasising the need for high-quality, culturally relevant multimedia, like using native speakers for pronunciation. Culturally relevant and pedagogically sound elements could effectively enhance learning outcomes, PU, and PEOU.

7.7.4 Colour and Font Selections

Students criticised the e-book's visual design, noting the unharmonious purple and green colour scheme and small, difficult-to-read fonts, which negatively affected user comfort and satisfaction, echoing interface design research. Bozkurt and Bozkaya (2015) highlighted aesthetic appeal and readability as vital, while Liaw and Huang (2016) demonstrated that design elements influenced self-efficacy and engagement. Findings showed that poor visual

coherence and legibility reduced PU and PEOU, with navigation issues undermining confidence in the system. These issues aligned with universal design principles emphasising effectiveness, visual harmony, and cultural appropriateness (Al-Wabil et al., 2006).

7.7.5 Conclusion

Cycle 2 findings revealed several interconnected challenges for students using the AFL interactive e-book, affecting both PU and PEOU. Unclear instructions, limited scaffolding, and a lack of orientation hindered engagement; technical issues with navigation, device compatibility, and input methods disrupted usage. Multimedia elements and visual design shortcomings further reduced comfort and satisfaction. While the e-book presented a promising digital language learning framework, improvements in instructional clarity, technical performance, and media quality were required to enhance student engagement and progress.

Before starting the third cycle and collecting data from AFL students and teachers, most identified challenges were resolved during the refinement phase.

7.8 Cycle Three: RQ7 – AFL Students’ Perspectives on the Adoption of the Alif Ba’a E-Book

This section discusses the findings from Cycle 3 of the DBR study, which quantitatively examined AFL students’ perceptions of the refined Alif Ba’a interactive e-book. Specifically, it addresses RQ7: “To what extent do the PU and PEOU of the AFL interactive e-book influence AFL students’ BI to adopt it?” The discussion is organised around key themes from the quantitative data analysis: PU, PEOU, BI, convenience, compatibility, media richness, and interactivity.

Respondents found that the e-book improved their writing and reading skills, aligning with findings from Letchumanan and Tarmizi (2011) and Nazari and Abdekhoda (2021) that linked perceived learning gains to technology adoption. While students generally perceived the e-book positively, some questioned its long-term effectiveness for retention and motivation, suggesting its benefits were more evident in immediate skill acquisition. This resonated with Huang et al. (2012) and Woody et al. (2010), who reported similar results for

e-books and print materials. Nevertheless, the widespread acceptance supported the TAM's emphasis on PU (Davis, 1989).

Students reported high satisfaction with the Alif Ba'a e-book's user-friendly interface, which facilitated learning by minimising technical distractions, supporting the ease of use aspect of the TAM (Davis et al., 1989). The positive perceptions aligned with those of Lai and Ulhas (2012) and Mizher and Alwreikat (2023), which emphasised how usability enhanced PU and adoption. Additionally, Ngafeeson (2011) noted that reducing user effort increased engagement and satisfaction. However, some students experienced access or submission challenges, echoing concerns from Jin (2014) and Smeda (2017) about how interface issues could impact user perceptions. These findings underscored the importance of seamless functionality in maintaining satisfaction and acceptance.

BI, defined by Davis et al. (1989), indicates willingness to adopt technology and predicts use. For the Alif Ba'a e-book, students intended to continue using and recommending it, indicating satisfaction linked to PU and PEOU. This accorded with research identifying BI as a principal determinant of adoption (Jin, 2014; Lawson et al., 2018; Maduku, 2015; Smeda, 2017; Yoo & Roh, 2019). Hsiao and Tang (2014) similarly affirmed BI's predictive reliability in educational technology, underscoring its importance for sustainable language-learning adoption.

Students valued the e-book's flexibility and convenience for practice anywhere, although some expressed mixed views on its effectiveness compared to traditional methods. These findings aligned with research indicating that perceived convenience facilitated e-learning adoption, which was moderated by technological comfort and prior experience (Alhammad & Ku, 2016; Chen, 2015). Moreover, ease of navigation and usability likewise influenced acceptance, echoing Jin (2014) and Smeda (2017) on interface design and self-efficacy. Technical issues—glitches and navigation problems—were obstacles, resonating with Bulur and Gönül (2020) on reliability and responsiveness. Addressing interface and operational issues was pivotal to enhancing satisfaction and intention to adopt e-books for language learning.

Compatibility significantly influenced students' intentions, as they perceived the e-book as

aligning with their technological competencies, curricular structures, and personal learning goals, in line with Rogers's (2003) DIT. The Alif Ba'a e-book's alignment with students' environments and preferences boosted PU and PEOU, supporting findings by Jin (2014) and Lai and Ulhas (2012). These results indicated that seamless integration into established educational practices facilitated adoption.

Students recognised that media richness enhanced their learning experiences, valuing audio guides, visual demonstrations, and interactive animations for pronunciation and letter formation. These findings aligned with Bozkurt and Bozkaya's (2015) e-book design criteria, which emphasised clarity, interactivity, and interface quality. While minor criticisms were noted regarding animation speed and audio clarity, like Hwang and Wang (2018) and Ebied and Rahman (2015), the need for ongoing improvement was evident. Zhang et al. (2020) confirmed that audiovisual and interactive features in mobile-assisted e-books enhanced user experience.

Students' perceptions of the Alif Ba'a e-book's interactivity were highly positive. They enjoyed drag-and-drop tasks, minimal-pair drills, and feedback-driven writing exercises, which fostered engagement. These aligned with Bozkurt and Bozkaya's (2015) criteria for meaningful interaction and pedagogically sound design. However, some found task instructions unclear, highlighting the need for better scaffolding. The integration of technological tools and learner preferences improved PU and PEOU, supporting findings from Jin (2014) and Lai and Ulhas (2012).

7.8.1 Conclusion

Cycle 3 findings showed that AFL students found the Alif Ba'a interactive e-book valuable and engaging for learning the Arabic alphabet. Key drivers of students' BI were PU and PEOU, supporting the e-book's effectiveness in enhancing reading, writing and pronunciation. Features like media richness and interactivity facilitated acceptance, aligning with the TAM and the work of Lai and Ulhas (2012), Bozkurt and Bozkaya (2015), and Zhang et al. (2020). While most students were satisfied, some students reported issues with access and task difficulty, as identified by Jin (2014) and Smeda (2017). These results highlighted the need for refinement to sustain usability and multimedia quality, with Alif

Ba'a exemplifying theory-driven integration in AFL education.

7.9 Cycle Three: RQ8 – AFL Teachers' Perspectives on the Adoption of the Alif Ba'a E-Book

This section addresses RQ8: "To what extent do PU and PEOU of the AFL interactive e-book influence AFL teachers' BI to adopt it?" The analysis examines how PU and PEOU impacted teachers' intentions, focusing on themes such as convenience, compatibility, media richness, interactivity, and adoption intention.

Findings from Cycle 3 indicated that AFL teachers held strong positive perceptions of the e-book's usefulness, affirming its role in enhancing instruction of the Arabic writing system and supporting various learner profiles. This reflected Davis's (1989) original concept of PU as the belief that a system improves performance, and is congruent with Smeda (2017), Liao et al. (2018), and Pilco (2017), who demonstrated that PU was a significant predictor of teachers' BI to adopt educational technologies. Alhammad and Ku (2016) also noted the positive effects of multimedia tools on pronunciation and engagement, while Golonka (2014) emphasised how digital technologies met diverse learning needs and fostered motivation. The results also paralleled those of Erradi et al. (2012) and Trigui et al. (2012), who found that multimedia and interactivity aligned with instructional objectives, enhancing educational effectiveness, with perceived effectiveness being a key driver for technology adoption (Mizher & Alwreikat, 2023). Collectively, these findings corroborated the TAM, confirming that strong perceptions of usefulness underpinned intentions to adopt instructional technologies.

Teachers generally rated the Alif Ba'a e-book as accessible and user-friendly. The intuitive layout, clear instructions, and minimal technical challenges were highlighted, in line with Davis's (1989) construct of PEOU. The user-friendly design eased barriers for novice users, allowing teachers to prioritise pedagogy over technical issues. The findings were supported by studies establishing the importance of straightforward navigation and minimal cognitive burden in enhancing PU and BI (Phadung & Dueramae, 2018; Salloum & Shaalan, 2018; Smeda, 2017). Although some teachers reported minor issues, such as lag in feedback response, echoing concerns from Alhammad (2017) about e-book performance, refinements

between Cycles 2 and 3 addressed most usability concerns.

Compatibility was identified as a crucial factor influencing the adoption of the Alif Ba'a e-book, aligning with curricular objectives, pedagogical strategies, and infrastructure. This observation supported Rogers's (2003) definition of compatibility. In addition, prior research highlighted compatibility as central to PU and PEOU in the TAM (Chau & Hu, 2001; Jin, 2014; Lai & Ulhas, 2012; Wu & Wang, 2005). A few noted limited scalability for advanced learners—echoing Nishat and Islam's (2015) notion of adaptable content—the prevailing sentiment was that Alif Ba'a complemented existing methods, facilitating widespread adoption in Arabic as an AFL program.

Convenience was identified as a key advantage, with educators praising the e-book's accessibility across devices for flexible use in classrooms and remote settings. Teachers highlighted efficient digital access, multimedia integration, and reduced reliance on printed materials. These observations aligned with Yoon and Kim's (2007) concept of perceived convenience, supported by Gueval et al. (2015) on portability and usability. Within the TAM, this convenience related to PU and PEOU, enhancing the intentions to adopt the e-book, as demonstrated by empirical studies (Davis et al., 1989; Dillon & Morris, 1996) and usability research (Baker-Eveleth & Stone, 2015; Luo et al., 2021; Qazi et al., 2018).

Media richness was widely endorsed, with teachers highly valuing features like audio pronunciation guides, animated demonstrations, and engaging visuals, which aligned with the Media Richness Theory (Daft et al., 1987) and Mayer's Cognitive Theory of Multimedia Learning (2005), which proposed that multimodal resources enhanced comprehension and retention. The Alif Ba'a e-book aligned with Bozkurt and Bozkaya's (2015) criteria for interactive e-books. It reflected research showing that media-rich environments enhanced user engagement and satisfaction (Dahlan et al., 2024).

Teachers favoured the e-book's interactive features, particularly the "Practice" and "Produce" sections, which they believed enhanced student learning and engagement. This aligned with Bozkurt and Bozkaya's (2015) effective e-book design criteria, emphasising interactivity and Widyantoro's (2019) PPP approach. However, some teachers were uncertain about the "Produce" section, indicating a need for better training or simpler tasks.

The integration of U, PEOU, compatibility, convenience, media richness, and interactivity led to a strong BI to adopt the Alif Ba'a e-book. Teachers' readiness to recommend it indicated positive social validation in the teaching community. These findings aligned with the TAM, which stated that PU and PEOU jointly determine BI, supported by empirical research (Jin, 2014; Liao et al., 2018; Ngafeeson, 2011; Smeda, 2017).

7.9.1 Conclusion

The findings from Cycle 3 demonstrated that AFL teachers' intentions to adopt the Alif Ba'a e-book was shaped by PU and PEOU, in line with the TAM. Compatibility, convenience, media richness, and interactivity also played significant roles. Teachers recognised the e-book's effectiveness for beginners and its intuitive design. The intentions to recommend the e-book reflected its perceived value and social validation within the AFL community. They underscored the Alif Ba'a e-book's potential as an educational tool that might benefit from further refinement for scalability.

7.10 Cognitive Sub-Elements and Passey's LEF in the Alif Ba'a E-Book

This section critically analyses the cognitive sub-elements at play in the Alif Ba'a interactive e-book, explicitly through the lens of Passey's LEF (2011). LEF conceptualises learning as an interplay between megacognitive, metacognitive, cognitive, social, and societal elements, with cognitive engagement specifically stimulated through both internalisation (e.g., attention, acquisition) and externalisation (e.g., writing, speaking, drawing, movement, and task completion) (Passey, 2011). Drawing on rich data from teachers and students, this section demonstrates how the Alif Ba'a e-book's design activated these sub-elements and aligned with LEF's core pedagogical principles.

7.10.1 Writing as a Cognitive Sub-Element in LEF

Within Passey's framework, writing represents a primary mechanism for externalising internal cognitive processes. Teachers recognised that structured, purposeful writing activities embedded in the e-book directly supported students in moving knowledge from internal conceptualisation to visible, assessable skills. The focused digital handwriting practice, paired with immediate feedback and multimodal prompts, not only enabled efficient

script mastery but also minimised cognitive overload—precisely reflecting LEF’s emphasis on balancing task complexity and learner capacity (Mayer, 2005).

Students’ responses confirmed the alignment with LEF, highlighting writing as the key activity for cognitive engagement. By forming letters with a stylus or finger, students externalised their understanding of the Arabic script, activating their perceptual, motor, and memory systems. This multimodal engagement is essential to LEF, which emphasises that effective learning occurs through interaction across sensory and expressive domains (Passey, 2011). For Arabic’s complex script, writing is crucial for consolidating letter recognition and production.

Consequently, the e-book’s writing tasks can be viewed as instantiations of LEF’s cognitive sub-elements. These activities converted cognitive processes into outputs, reinforcing the theoretical proposition that externalisation significantly enhances language learning effectiveness (Passey, 2011). The observed learning outcomes and participant perceptions strongly corroborated the alignment between the e-book’s design and LEF principles.

7.10.2 Movement and Interactivity: Externalising Cognition per LEF

Movement and interactivity are critical in Passey’s LEF, enhancing engagement and externalisation. The Alif Ba’a e-book operationalised these through drag-and-drop, matching, and rearrangement activities. Teachers observed these kinaesthetic tasks, shifting students from passive receivers of information to active constructors of knowledge, directly aligning with LEF’s vision of engaging, learner-centred environments (Passey, 2011). The interactive activities, merging physical manipulation with cognitive challenge, resonated with LEF’s principle that learning is enriched when learners externalise understanding through varied sensory and motor pathways (Passey, 2011). Furthermore, memory games, crosswords and matching promoted participation, rehearsal, and recall. Students’ affective responses—enjoyment, motivation, persistence—indicated effective externalisation and engagement within LEF.

7.10.3 LEF as the Organising Principle

Teacher and student data demonstrated the utility of Passey’s LEF as an analytical and design

framework for digital language learning. The e-book's effectiveness was attributed to its operationalisation of LEF's core insight: learning is most effective when internal cognitive activity is externalised through action and interaction (Passey, 2011). Also, teachers appreciated that writing and interactivity facilitated completion, reflection and feedback—central to LEF's cognitive cycle. Students reported that kinaesthetic, multimodal externalisation not only reinforced knowledge but supported engagement and self-efficacy, as anticipated by LEF's holistic model. Moreover, the reciprocal relationship between technology design and pedagogy is rooted in LEF's premise that learning environments must structure opportunities for internalisation (e.g., focused attention, mental rehearsal) and externalisation (e.g., writing, moving, speaking, creating). The Alif Ba'a e-book, in its features, seeks to embody this balance.

7.11 Chapter 7 Summary

This chapter demonstrates that the Alif Ba'a interactive e-book has significant potential in addressing key challenges in teaching the Arabic writing system to AFL learners. Employing a DBR methodology, the study refined the e-book through three iterative cycles, incorporating user feedback to enhance pedagogical alignment and usability. Its effectiveness depends on balancing PUs and PEOU as outlined by the TAM. Initial findings highlighted challenges in online Arabic instruction, underscoring the need for interactive, customisable tools. Teachers and students valued the e-book's multimedia features and flexibility but reported usability and technical issues. Iterative enhancements — adaptive difficulty, improved feedback and offline functionality — increased adoption intentions and enhanced learning outcomes, affirming the e-book's alignment with cognitive frameworks such as Passey's LEF.

The study shows that digital language-learning tools need more than just technical innovation; they must be user-centred and theory-driven. While the Alif Ba'a e-book exemplifies how media-rich platforms can transform AFL instruction, ongoing challenges — including technical reliability, learner flexibility, and access — persist. These findings enhance theory and practice by demonstrating how iterative, research-informed design — guided by the TAM, LEF, and PPP — can successfully bridge the gap between digital

innovation and meaningful language learning.

Chapter 8: Conclusions

8.1 Introduction

This concluding chapter synthesises key findings from the research in developing a digital pedagogy framework for the Alif Ba'a interactive e-book designed for AFL instruction. Using DBR methodology, the study developed and evaluated the e-book through three iterative cycles to tackle challenges in teaching the Arabic writing system online after the shift from F2F instruction. As noted by Barab and Squire (2004), the iterative approach in DBR enables researchers to design more effective educational interventions by leveraging their experiences to enhance learning and teaching. The research specifically focused on the difficulties of teaching the Arabic alphabet online, where mastery involves observing the teacher form each of the 28 consonants, some of which serve as short vowels.

The research was guided by four core theoretical frameworks: Passey's LEF (2011), Davis's TAM (1989), the PPP approach (Widyantoro, 2019), and Bozkurt and Bozkaya's IEEC (2015). Integrating these frameworks within the DBR methodology constituted a novel approach to developing and evaluating digital language-learning tools for AFL.

A sequential mixed-methods design across the three DBR cycles permitted a comprehensive examination of both pedagogical and technological effectiveness of the Alif Ba'a e-book. This chapter summarises the study context, reports key findings in relation to each research question across the three iterative cycles, and outlines contributions to knowledge (theoretical, practical and methodological), limitations affecting scope and generalisability, and recommendations for practice and future research, concluding with a reflective account of the researcher's journey and the study's significance for digitally mediated Arabic literacy.

8.2 Synopsis of the Study

8.2.1 Research Context and Rationale

This research emerged in response to the urgent need for practical digital tools to teach the Arabic writing system following the global shift to online instruction during the Covid-19 pandemic. The Arabic language presents unique challenges for foreign language learners,

particularly regarding its writing system, which requires observing the teacher forming each of the 28 consonants, some of which serve as long vowels. As highlighted in the study, the transition to digital platforms revealed significant limitations, including the potential loss of proficiency in Arabic handwriting as students became overly reliant on auto-correction features. Additionally, maintaining academic integrity in online assessments presented substantial challenges for AFL educators. Moreover, the diglossic nature of Arabic, with distinct Modern Standard Arabic and regional dialects, further complicates instruction, particularly in online environments where nuanced guidance on script formation and pronunciation is difficult to deliver effectively. The research specifically addressed these challenges by developing a digital pedagogy framework embedding an interactive e-book designed to facilitate Arabic script acquisition in online contexts, with particular attention to the visual and motor aspects of writing Arabic characters.

8.2.2 Key Findings

The first cycle of the DBR study identified challenges in teaching the Arabic writing system online. Through exploratory focus groups addressing RQ1, I identified two themes: *Technology Overwhelms Teachers and Students* and *Online Arabic Alphabet Teaching Issues*. The former revealed systemic barriers, including the lack of kinaesthetic modelling for letter formation, cognitive overload and technical difficulties. The latter highlighted pedagogical challenges inherent to Arabic script: the inability to monitor stroke order and direction in real-time, pronunciation difficulties exacerbated by limited visibility of mouth movements, and excessive time demands for individualised feedback. Regarding RQ2, teachers articulated their ideal digital tool preferences, emphasising interactivity, real-time feedback mechanisms, customisability for diverse learners, and varied activity types—findings that directly informed the development of the Alif Ba’a e-book prototype.

The second DBR cycle examined teachers’ and students’ perceptions of the initial e-book implementation through RQ3–RQ6. Teachers’ evaluations (RQ3) revealed PU due to multimedia elements and curriculum alignment, alongside high PEOU stemming from the intuitive interface. Analysis of challenges (RQ4) identified three principal themes: pedagogical issues, technological issues, and multimedia issues. Student perceptions (RQ5) were positive regarding mobile compatibility and interactive features. Their reported

challenges (RQ6) centred on unclear instructions, navigation difficulties, device compatibility issues, Arabic input method constraints, and multimedia design shortcomings. These findings collectively informed refinements to the e-book before Cycle 3.

The third cycle quantitatively examined adoption intentions through RQ7 and RQ8, revealing that both students and teachers demonstrated strong BI to adopt the refined Alif Ba'a e-book, with PU and PEOU serving as primary determinants in alignment with the TAM. The e-book's perceived effectiveness significantly influenced students' adoption intentions (RQ7) in enhancing writing and reading skills, intuitive interface design, flexibility for anytime/anywhere practice, compatibility with existing technological competencies, media richness through audiovisual demonstrations, and interactive features like drag-and-drop tasks. Similarly, teachers' adoption intentions (RQ8) were driven by the e-book's pedagogical effectiveness, user-friendly design, compatibility with curricular objectives, convenience across teaching contexts, media richness supporting pronunciation instruction, and interactive components enhancing student engagement.

8.3 Overarching Conclusions

This study demonstrated that iterative, theory-informed design significantly enhances both the pedagogical effectiveness and user acceptance of digital tools for Arabic script acquisition. Analysis across three DBR cycles revealed a clear trajectory of improvement: challenges such as technological overload and inadequate feedback were systematically addressed through refinements in interactivity, navigation, and functionality. By the final cycle, adaptive difficulty, improved feedback, and offline access significantly boosted satisfaction for both teachers and students. Theoretical frameworks—including Passey's LEF (2011), Davis's TAM (1989), the PPP Approach (Widyantoro, 2019), and Bozkurt and Bozkaya's IEEC (2015)—provided critical scaffolding for design decisions. Notably, alignment with Passey's (2011) cognitive principle of externalisation enabled learners to engage meaningfully with content, supporting cognitive processing and skill development through structured practice and production activities.

Ultimately, the Alif Ba'a e-book showed significant promise in addressing key challenges in teaching the Arabic writing system to elementary-level AFL learners. However, persistent

issues related to technical reliability, accessibility, and pedagogical flexibility underscored the complex interplay between technological innovation and effective language instruction. The central conclusion was that successful digital language tools must be more than technically advanced—they must be grounded in user-centred, theory-driven design tailored to the specific cognitive, motor, and contextual needs of learners. This principle extends beyond Arabic language education, providing insights for designing technology-enhanced learning environments for other non-Latin writing systems. Effective digital pedagogy, therefore, lies not in privileging technology or pedagogy in isolation, but in their thoughtful and balanced integration.

8.4 Contributions to Knowledge

8.4.1 Advancing Digital Pedagogy for Arabic Language Learning

This research makes a significant original contribution to knowledge through the innovative integration of four conceptual frameworks within the DBR methodology to develop and evaluate the Alif Ba'a interactive e-book for teaching the Arabic alphabet.

8.4.2 Theoretical Contributions

The research enhances understanding of Arabic script acquisition by showing how various frameworks interact to tackle its unique challenges of Arabic script acquisition. Passey's (2011) foregrounded cognitive externalisation shaped activities' design, making thinking visible; the PPP approach sequenced guided exposure to independent use; the TAM showed how PU and PEOU drove BI; and Bozkurt and Bozkaya's IEEC shaped content clarity and coherence. Together, these frameworks translated theory into design features that supported practice and improved learner engagement.

Furthermore, the research validated Bozkurt and Bozkaya's IEEC within AFL instruction, showing that effective e-book content presentation rested on integrity, coherence and connectivity, requiring alignment of content and media, a clear hierarchical structure, and strong internal connections. The e-book presented accurate, well-organised information that enhanced learning. The study demonstrated how digital tools, such as images and videos, reinforced text, while logical sequencing facilitated navigation and progression in learning.

Challenging the assumption that technical affordances alone ensured learning, the study highlighted that digital language tools required user-centred, theory-driven design tailored to learners' needs. This insight emphasised adaptive, learner-centred practice and showed how iterative, research-informed design — guided by the , LEF and PPP — could bridge digital innovation and meaningful language learning.

8.4.3 Practical and Policy Contributions

This research presented a practical blueprint for creating low-cost, multi-platform e-books for university AFL programmes. The Alif Ba'a e-book, developed with Book Widgets, showcased how to create effective digital resources without extensive programming or significant costs, enhancing accessibility for institutions with limited resources. It provided evidence-based design guidance for Arabic script presentation, highlighting the role of visual aids in comprehension. At the same time, interactive elements like games and quizzes fostered engagement and mastery of writing. A critical analysis suggested balancing information density to avoid cognitive overload while keeping learners engaged. The findings emphasised the need for institutional policies that accommodate the time required for developing effective educational technology, moving beyond conventional semester-based timelines.

8.4.4 Methodological Contributions

The study makes important methodological contributions by demonstrating the value of DBR in small-cohort language courses and providing a clear template for mixed-methods triangulation. Its sequential exploratory mixed-methods design across three DBR cycles enabled a rigorous examination of both pedagogical and technological effectiveness. Qualitative data from focus groups and interviews were used to inform the development of quantitative instruments, thereby creating a strong evidence base for iterative design decisions. Additionally, the research addressed a notable gap concerning the acceptance of interactive e-books among AFL learners. Whereas prior studies have tended to treat e-books in general language-learning contexts, this project investigated their application explicitly in AFL instruction. By focusing on AFL learners' specific needs and challenges, the study supplied insights that could directly inform the design and deployment of more effective

digital resources for Arabic language instruction.

Critically, the study demonstrated the necessity of balancing technological innovation with effective pedagogical practices. This insight has significant implications not only for Arabic language instruction but for digital language learning more broadly, suggesting that the most effective digital tools integrate technological capabilities with sound pedagogical principles rather than prioritising one dimension over the other. The research thus provides both a theoretical framework and practical methodology for developing digital language learning resources that are both technologically sophisticated and pedagogically sound, representing a substantial contribution to the field of technology-enhanced language learning.

8.5 Limitations

A key limitation of DBR, as noted in section 4.6, is its time-consuming nature, limited generalisability, and ethical complexities, which must be carefully managed for methodological transparency and validity. DBR requires prolonged engagement with participants and multiple cycles of design and evaluation, demanding substantial time and resources. Multi-site deployment and time-zone differences introduced scheduling and access constraints that affected coordination, testing windows, and participant availability. Although structured planning aided in meeting deadlines, the lengthy duration remained a common constraint. Additionally, DBR findings are often context-specific, limiting their applicability across different settings (Hoadley & Campos, 2022; Parmaxi & Zaphiris, 2020), necessitating cautious interpretation. Ethical challenges—notably the need for multiple IRB approvals—added administrative burden and excluded some universities despite approvals elsewhere, further narrowing the sample. While DBR and a sequential mixed-methods approach supported iterative development, the methodology’s emphasis on process may have under-represented long-term learning outcomes.

Access challenges also constrained this study, as varying technological infrastructure and Internet connectivity likely affected the consistency of the learning experiences and limited participation across contexts. The study’s focus on the Arabic alphabet addressed a specific pedagogical need but restricted its scope to early-stage language learning and reduced its relevance to advanced AFL instruction. Furthermore, reliance on self-reported questionnaires

and interviews introduced potential response bias and social desirability effects; although data triangulation mitigated these concerns, the findings retain a subjective element. Collectively, these constraints — access, scope, methodological emphasis, and data validity — should be considered when applying the study’s outcomes to broader AFL educational contexts.

8.6 Recommendations for Future Research

8.6.1 Development of an Integrated Theoretical Framework

Future research should prioritise developing a comprehensive theoretical framework for digital language learning, especially for AFL. This study demonstrated the value of integrating multiple frameworks—including the TAM, LEF, the PPP Approach, and Bozkurt and Bozkaya’s IEEC—within DBR. However, they currently function in parallel rather than as parts of a unified structure. I therefore propose an Integrated Digital Language Learning Framework (IDLLF) that combines these perspectives and applies them across proficiency levels. The study does not operationalise an IDLLF; instead, its findings motivate a targeted programme of development and evaluation to specify and test such a framework in AFL contexts. Future research should define an IDLLF with clear hierarchical relationships, using DBR as the central methodology and other frameworks providing specific insights at various stages. The programme should: use the TAM to assess user acceptance and adoption; LEF to guide pedagogical design across cognitive, metacognitive, social and societal dimensions; PPP to structure learning sequences and progression; and IEEC criteria to evaluate interactivity and multimedia integration. The proposed framework must also embed robust accessibility provisions (including visual impairments and learning differences), cultural-adaptation mechanisms that preserve linguistic accuracy, and a validated dynamic assessment component for immediate outcomes and longer-term retention of script-acquisition skills.

Empirical operationalisation of the IDLLF across diverse AFL settings is the next critical step. Researchers should systematically test its efficacy, refine components using implementation data, and explore adaptation for other languages with complex writing systems and varied proficiency levels. Such work would advance digital language pedagogy

by clarifying theoretical linkages, strengthening causal inferences, and improving the predictive capacity of digital learning tools. Systematic testing, iterative refinement and cross-linguistic validation will be essential to translate the IDLLF from conceptual integration into a practical, evidence-based guide for designers, teachers and institutions.

8.6.2 Recommendation for AI Integration in Future AFL E-Books

Building upon the promising results of the Alif Ba'a interactive e-book, future research should investigate the integration of artificial intelligence (AI) technologies to address several persistent challenges identified in this study. The current iteration of the e-book, while effective in many respects, still faces limitations in personalised feedback, pronunciation assessment, and adaptive learning pathways that AI could significantly enhance.

Future work should investigate three complementary strands. First, speech-recognition systems tuned to Arabic phonology—particularly emphatic consonants and nuanced vowel distinctions—could deliver granular, immediate feedback to support accurate articulation. Second, intelligent handwriting-recognition tools tailored to the complexities of Arabic script (right-to-left orientation, letter connectivity, and diacritics) could provide precise guidance on stroke formation, orthographic accuracy, and script fluency. Third, adaptive, data-driven pathways should dynamically adjust task difficulty, sequencing, and content in response to learner performance. At the same time, intelligent recommendation mechanisms can link new material to prior knowledge and tailor thematic vocabulary to learners' interests and proficiency levels. Collectively, these directions align with the metacognitive aims articulated in LEF by supporting self-monitoring and targeted remediation, thereby making digital AFL learning more responsive, engaging, and effective, all while preserving the study's main objectives.

8.7 Final Reflection

This research journey has deepened my understanding of how technology, pedagogy, and language learning converge, particularly in the realm of AFL. A key realisation is that meaningful digital language-learning tools require more than technical advancement: they demand theory-driven, user-centred design responsive to learners' realities and complexities.

Through the Alif Ba'a e-book project, I witnessed how interactive, media-rich platforms can transform AFL instruction when design is firmly rooted in linguistic challenges and sound pedagogical principles; yet, persistent issues—technical reliability, accessibility, and flexibility for diverse learners—remind me that technology alone cannot resolve the multifaceted problems of language education.

Throughout this research, the iterative, research-informed approach I followed, guided by frameworks such as the TAM, the Passey's LEF, PPP, and the IEEC, reinforced that educational technology must balance technological capability with strong pedagogy rather than prioritising one at the expense of the other. The findings consistently show that digital tools should extend and enhance pedagogical possibilities without replacing teachers, preserving the human elements essential to language instruction. When used in the classroom, the Alif Ba'a e-book fostered greater learner autonomy and engagement; its technical limitations—particularly in handwriting and pronunciation—demonstrate that even sophisticated digital resources have boundaries, especially with a script as complex as Arabic.

A key insight is the importance of involving end users throughout the design and refinement process. Feedback from AFL teachers and students was crucial in shaping the e-book so that it better aligned with classroom needs and pedagogical expectations. Student and teacher perspectives informed vital refinements and underscored the necessity of a collaborative, user-centred approach to educational technology. This experience has reinforced for me that authentic, practical tools are those shaped in collaboration with their intended users—tools that are both technologically advanced and practically useful.

As I conclude, the most enduring insight is the simplest: effective educational technology is not about the technology itself but about how it serves the fundamental goals of language teaching and learning. The Alif Ba'a e-book, with its strengths and limitations, ultimately succeeds insofar as it supports learners in mastering the Arabic writing system and empowers teachers to deliver more effective instruction. That technology must serve pedagogy, rather than the reverse, is the principal lesson from this research and will continue to guide future developments in digital language learning.

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Appendix 1: Ethics Approval



13th August, 2020

Dear Hany Abdelrhem,

Thank you for submitting your ethics application and additional information for "Exploring a Digital Pedagogy Framework that embeds an Interactive E-Book for Arabic as a Foreign Language Instruction". The information you provided has been reviewed and I can confirm that approval has been granted for this project".

As principal investigator your responsibilities include:

- ensuring that (where applicable) all the necessary legal and regulatory requirements in order to conduct the research are met, and the necessary licenses and approvals have been obtained;
- reporting any ethics-related issues that occur during the course of the research or arising from the research (e.g. unforeseen ethical issues, complaints about the conduct of the research, adverse reactions such as extreme distress) to your Supervisor.
- submitting details of proposed substantive amendments to the protocol to your supervisor for approval.

Please do not hesitate to contact me if you require further information about this.

Kind regards

A handwritten signature in blue ink that reads "Alice Jesmont".

Alice Jesmont
TEL Programme Administrator

Head of Department
Professor Paul Ashwin, BA, MSc, PhD
Professors
Carolyn Jackson, BSc, PhD
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Appendix 2. Focus-group question guides (Teachers)

Project Title: A Design-Based Research Investigation of the Acceptance of an Interactive E-Book for Arabic as a Foreign Language Instruction

Name of Researchers: Hany Abdelrhem

Email: h.abdulazizabdelrahem@lancaster.ac.uk

Cycle 1: Qualitative Research Questions:

RQ1: What challenges are encountered in teaching the Arabic writing system?

RQ2: What digital tool would be ideal for teaching the Arabic writing system?

Before the interview:

- An invitation email will be sent to possible participants.
 - The email will include:
 - timetable.
 - consent form
 - participant information sheet
 - instructions on how to sign and send them back to the researcher.
- A Zoom/Microsoft Teams invitation will be sent to participants who have accepted participation in the study.

Expected questions to be asked in the interview will be the following:

What digital tools have you used to teach online during the COVID-19 pandemic?

What are the challenges you faced while using this tool/software/application? Please tell me what, why and how?

What are the challenges/problems you face in teaching the Arabic writing system?

Have you used any paper-based or online electronic tools to teach the Arabic writing system? What did you like about these tools?

What is your dream digital tool for teaching the Arabic writing system? Please tell me what, why and how?

OR, if there is a new interactive e-book you wish to use in teaching the Arabic writing system online, what digital features do you want to see in this new software/application?

Features like:

<ul style="list-style-type: none"> ■ Content <ul style="list-style-type: none"> ○ Language usage ○ Learning activities with learning objectives. ○ Assessment and evaluation 	<ul style="list-style-type: none"> ■ Multimedia <ul style="list-style-type: none"> ○ The attractiveness of the content ○ Content-media coherence
<ul style="list-style-type: none"> ■ Interface <ul style="list-style-type: none"> ○ User-friendly interface ○ Navigation tools ○ Bookmarking ○ Searchability ○ Layout design ○ Ease of use ○ Usefulness ○ Accessibility 	<ul style="list-style-type: none"> ■ Technology <ul style="list-style-type: none"> ○ Online /offline functionality ○ Multiplatform support ○ Support services

Which of the following cognitive sub-elements do you think affected your learning?

- **Motor Stimulus:**

Writing- Reporting- Speaking- Presenting- Drawing- Completing- Moving

Appendix 3. Research Questions

Cycle 1: Qualitative Research Questions:

RQ1: What challenges are encountered in teaching the Arabic writing system?

RQ2: What digital tool would be ideal for teaching the Arabic writing system?

Teachers: Cycle 2: Qualitative Research Questions:

QR 3: What are AFL teachers' perceptions of using the AFL interactive e-book to teach the Arabic writing system?

QR 4: What are the teacher challenges related to the AFL interactive mobile e-book's PEOU and PU?

Students: Cycle 2: Qualitative Research Questions:

QR 5: What are AFL students' perceptions of using the AFL interactive e-book to learn the Arabic writing system?

QR 6: What are the student challenges related to the AFL interactive mobile e-book's PEOU and PU?

Cycle 3: Quantitative Research Question(s):

RQ7: To what extent do PEOU and PU influence students' behavioural intention to adopt the interactive e-book?

RQ8: To what extent do PEOU and PU influence teachers' behavioural intention to adopt the interactive e-book?

Appendix 4. Semi-structured interview questions guide (Teachers)

Semi-structured-interview-questions guide (Teachers)

Project Title: A Design-Based Research Investigation of the Acceptance of an Interactive E-Book for Arabic as a Foreign Language Instruction

Name of Researchers: Hany Abdelrhem

Email: h.abdulazizabdelrahem@lancaster.ac.uk

Teachers: Cycle 2: Qualitative Research Questions:

QR 3: What are AFL teachers' perceptions of using the AFL interactive e-book to teach the Arabic writing system?

QR 4: What are the teacher challenges related to the ASL interactive mobile e-book's PEOU and PU?

Before the interview:

- An invite email will be sent to possible participants.
 - The email will include:
 - timetable.
 - consent form
 - participant information sheet
 - instructions on how to sign and send them back to the researcher.
- If participants wish to meet face-to-face, I will arrange a meeting at either my office or their workplace in Qatar. I will prepare an audio recording device to record the semi-structured interviews.
- A Zoom/Microsoft Teams invitation will be sent to participants who have accepted participation in the study and reside overseas.

Expected questions: -

Have you used the e-book?

What are your perceptions in general?

Do you like it? Please tell me why and how?

If you do not like it? Please tell me why and how?

What are your perceptions regarding its features?

Please tell me what, why, and how?

Features like:

<ul style="list-style-type: none"> ■ Content <ul style="list-style-type: none"> ○ Language usage ○ Learning activities with learning objectives. ○ Assessment and evaluation 	<ul style="list-style-type: none"> ■ Multimedia <ul style="list-style-type: none"> ○ The attractiveness of the content ○ Content-media coherence
<ul style="list-style-type: none"> ■ Interface <ul style="list-style-type: none"> ○ User-friendly interface ○ Navigation tools ○ Bookmarking ○ Searchability ○ Layout design ○ Ease of use ○ Usefulness ○ Accessibility 	<ul style="list-style-type: none"> ■ Technology <ul style="list-style-type: none"> ○ Online /offline functionality ○ Multiplatform support ○ Support services

What are the challenges you faced while using the e-book? Please tell me what, why and how?

What are your recommendations to improve the e-book? Please tell me what, why and how?

Are you willing to use the e-book in your future courses? Please tell me why and how?

Do you recommend this e-book for any teacher to use in the future? Please tell me why and how?

What are the challenges your students faced while using the e-book? Please tell me what, why and how?

What are your students' recommendations to improve the e-book? If any, please tell me what, why and how?

Do you think that this e-book enhanced your students' learning of the Arabic writing system? Please tell me why and how?

Which of the following cognitive sub-elements do you think affected your teaching?

- **Motor Stimulus:**

Writing- Reporting- Speaking- Presenting- Drawing- Completing- Moving

Appendix 5. Semi-structured interview questions guide (Students)

Focus Group Interviews Questions Guide (Students)



Project Title: Exploring a Digital Pedagogy Framework that embeds an Interactive E-Book

for Arabic as a Foreign Language Instruction

Name of Researchers: Hany Abdelrhem

Email: h.abdulazizabdelrahem@lancaster.ac.uk

Before the interview:

- An invitation email will be sent to possible participants.
 - The email will include:
 - Timetable- consent form- participant information sheet -instructions on how to sign and send them back to the researcher- Zoom/Microsoft Teams invitation will be sent to participants who accepted to take part in the study, and who live overseas.

During the interview:

Expected questions: -

Have you used the e-book?

What are your perceptions in general?

Do you like it? Please tell me why and how?

If you do not like it? Please tell me why and how?

What are your perceptions regarding its features?

Please tell me what, why, and how?

Features like:

<ul style="list-style-type: none">▪ Content<ul style="list-style-type: none">○ Language usage○ Learning activities with learning objectives○ Assessment and evaluation▪ Multimedia<ul style="list-style-type: none">○ The attractiveness of the content○ Content-media coherence	<ul style="list-style-type: none">▪ Interface<ul style="list-style-type: none">○ User-friendly interface○ Navigation tools○ Bookmarking○ Searchability○ Layout design○ Ease of use○ Usefulness○ Accessibility▪ Technology<ul style="list-style-type: none">○ Online /offline functionality○ Multiplatform support○ Support services
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Follow-up Questions

What are the challenges you faced while using the e-book? Please tell me what, why and how?

What are your recommendations to improve the e-book? Please tell me what, why and how?

Any help from your Arabic teacher? Please tell me why and how?

Do you recommend this e-book for any student to use in the future? Please tell me why and how?

What are the challenges your peer-students faced while using the e-book? Please tell me what, why and how?

What are your peers' recommendations to improve the e-book? If any, please tell me what, why and how?

What are the challenges your teacher faced while using the e-book? Please tell me what, why and how?

What are your teacher's recommendations to improve the e-book? If any, please tell me what, why and how?

Which of the following cognitive sub-elements do you think affected your learning?

- Motor Stimulus:

Writing- Reporting-Speaking-Presenting-Drawing-Completing-Moving

Appendix 6 Participant information sheet



Participant information sheet

Title: Exploring a Digital Pedagogy Framework that embeds an Interactive E-Book for Arabic as a Foreign Language Instruction

For further information about how Lancaster University processes personal data for research purposes and your data rights please visit our webpage: www.lancaster.ac.uk/research/data-protection

I am Hany A. Rahem, a PhD student in the Department of Educational Research at Lancaster University, and I am an Arabic Instructor at Georgetown University in Qatar. I would like to invite you to take part in a research project on Arabic teachers'/students' perceptions of the use of an interactive electronic book to teach/learn the Arabic writing alphabet during the Spring semester of 2021.

Please take time to read the following information carefully before you decide whether or not you wish to take part.

What is the study about?

This study aims to identify Arabic as a foreign language (AFL) teachers' and students' perceptions of using an interactive e-book to teach and learn the Arabic writing system. Their perceptions and experiences will help in designing and developing the electronic book. There are two research questions for this study: 1. What are your perceptions of using the AFL interactive e-book to learn/teach the Arabic writing system? 2. What challenges are related to ease of use and perceived usefulness of the AFL interactive e-book? Ultimately, the study results will be used to better support teaching and learning of AFL in the future. The results will further contribute to the Arabic programmes and beyond. In addition, the results of the research will be submitted for publication in a thesis, academic journals and presented at academic conferences.

Why have I been invited?

I have approached you because you are a non-native speaker learning Arabic as a second language. I would like to gather information from you and other students at the same level of language competency to help me understand more about how students perceive using technology that might enhance their learning. Therefore, you are in a good position to be part of this study. Thus, I would be very grateful if you would agree to take part in this study.

What will I be asked to do if I take part?

If you decide you are happy to take part in the study, you will be asked to take part in a semi-structured interview. You will be asked a number of questions about your experience of using the interactive Arabic alphabet e-book, and your opinions about how to improve the e-book as well as any suggestion to enhance its features. All interviews will be audio-recorded and then transcribed for annotation. Semi-structured means that everyone will be asked the same core questions. Based on your responses and particular experience, I may ask you

v19-09-19

some further questions about your own experiences. The interview will, therefore, take the form of a structured conversation. You will be provided with a copy of the core questions at the time of the interview. I will use pseudonyms or codes when using your comments and feedback. I expect that each interview would take around 20 to 30 minutes of your time.

What are the possible benefits from taking part?

Taking part in this study will allow you to share your experiences on how to write the Arabic alphabet using online interactive exercises and the mobile e-book. You will be the first-hand user for implementing the e-book for learning the Arabic writing system.

Do I have to take part?

No. It's completely up to you to decide whether or not you take part. Your participation is voluntary. If you choose not to take part in this study, this will not affect your module learning and the way you are assessed in this course and programme.

What if I change my mind?

If you change your mind, you are free to withdraw at any time during your participation in the study and within two weeks after you took part in the study, without giving any reason. If you want to withdraw, please let me know, and we will extract any ideas or information (data) you contributed to the study and destroy them. However, it is difficult and often impossible to take out data from one specific participant when this has already been anonymised or pooled together with other people's data. Also, if you are involved in a focus group and then withdraw, your data will remain part of the study. Your data are part of the ongoing conversation and cannot be destroyed. However, we will try to disregard your views when analysing the focus group data.

What are the possible disadvantages and risks of taking part?

The time for the interview may last between 20-30 minutes. It is unlikely that there will be any major disadvantages to taking part in this study. I consider the psychological and social risks of participating in this research project to be minimal, given that you are an adult studying/working in a different institution.

Will my data be identifiable?

All the data collected from you will be stored in a dedicated, password-protected computer folder and will only be accessible to the researcher working on the study. Data (whether written or audio) will be encrypted, and it will not be stored with any names or other identifying information. The transcripts will not be accessible to anyone other than me. If, for any reason, you would like a copy of the information you provided after the study is completed, then please email Hany A. Rahem (h.abdulazizabdelrahem@lancaster.ac.uk)

Participants in the focus group will be asked not to disclose information outside of the focus group and with anyone not involved in the focus group without the relevant person's express permission.

How will we use the information you have shared with us and what will happen to the results of the research study?

I will use the information you share with me for research purposes only for my PhD thesis, research journals, and presentations in conferences. All information

v19-09-19

generated by the project will be stored in a secure computer folder, in line with the requirements of the Data Protection Act and Lancaster University Research Ethics Committee requirements.

Any publications or presentations arising from this project will not identify you by name, with codes or pseudonyms being used instead. When presenting transcripts and other research data in publications or presentations, I will also strive to limit the excerpts so that you are not easily identifiable. However, the names of the institutions participating in the study will be acknowledged and, given the highly specialised nature of your professional involvement, that does carry the risk that readers could identify you with prior knowledge of those institutions. I will, therefore, strive to ensure that you are not easily identifiable, but I should acknowledge that there is a minimal risk that your participation in this study could be identifiable.

How my data will be stored

Your data will be stored in encrypted files (that is no-one other than me, the researcher, will be able to access them) and on password-protected computers and a cloud folder. I will keep data that can identify you separately from non-personal information (e.g. your views on a specific topic). Following University guidelines, I will keep the data securely for a minimum of ten years.

What if I have a question or concern?

If you have any queries or if you are unhappy with anything that happens concerning your participation in the study, please contact me:

Hany Abdelrhem
hf194@georgetown.edu or
h.abdulazizabdelrahem@lancaster.ac.uk
uk
or 0097433295783

Or my supervisor:
Professor Don Passey,
d.passey@lancaster.ac.uk
or 0(044)1524 592314

If you have any concerns or complaints that you wish to discuss with a person who is not directly involved in the research, you can also contact:
Professor Paul Ashwin, Head of Department, Educational Research at Lancaster University
paul.ashwin@lancaster.ac.uk
and 0(044)1524 594443
Department of Educational Research
County South
Lancaster University Lancaster
LA1 4YD
United Kingdom

Sources of support

This study has been reviewed and approved by the Faculty of Arts and Social Sciences and Lancaster Management School's Research Ethics Committee.

Thank you for considering your participation in this project.

v19-09-19

Appendix 7 Informed Consent Form (Teachers-Student)



CONSENT FORM -Teachers-Students

Project Title: Exploring a Digital Pedagogy Framework that embeds an Interactive E-Book for Arabic as a Foreign Language Instruction

Name of Researchers: **Hany Abdelrhem**

Email: h.abdulazizabdelrahem@lancaster.ac.uk

Please tick each box *

1. I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.....	
2. I understand that my participation is voluntary and that I am free to withdraw at any time during my participation in this study and within 2 weeks after I took part in the study, without giving any reason. If I withdraw within 2 weeks of taking part in the study my data will be removed. If I am involved in an interview and then withdraw my data will remain part of the study. I understand that as part of the interview I will take part in, my data is part of the ongoing conversation and cannot be destroyed. I understand that the researcher will try to disregard my views when analysing the interview data, but I am aware that this will not always be possible.	
3. If I am participating in the interview, I understand that any information disclosed within the interview remains confidential, and I will not discuss the interview with or in front of anyone who was not involved unless I have the relevant person's express permission	
4. I understand that any information given by me may be used in future reports, academic articles, publications or presentations by the researcher/s, but my personal information will not be included, and all reasonable steps will be taken to protect the anonymity of the participants involved in this project. Anonymised data will be offered to Lancaster University's archive and will be made available to genuine research for re-use (secondary analysis)	
5. I understand that my name/my organisation's name will not appear in any reports, articles or presentations without my consent.	
6. I understand that any interviews will be audio-recorded and transcribed and that data will be protected on encrypted devices and kept secure.	
7. I understand that data will be kept according to university guidelines for a minimum of 10 years after the end of the study.	
8. I agree to take part in the above study.	

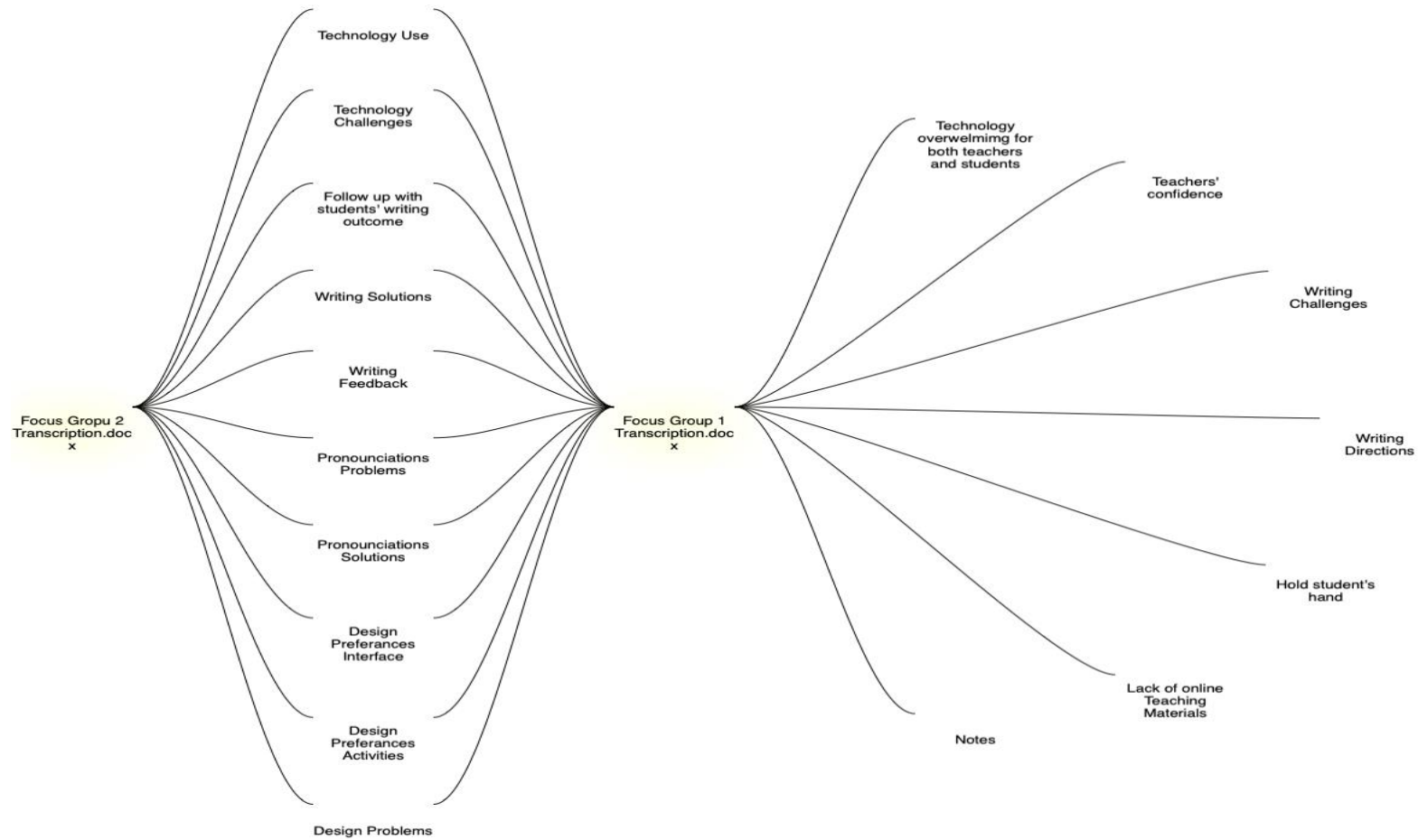
Name of Participant Date Signature

I confirm that the participant was allowed to ask questions about the study, and all the questions asked by the participant have been answered correctly and to the best of my ability. I confirm that the individual has not been coerced into giving consent, and that the consent was given freely and voluntarily.

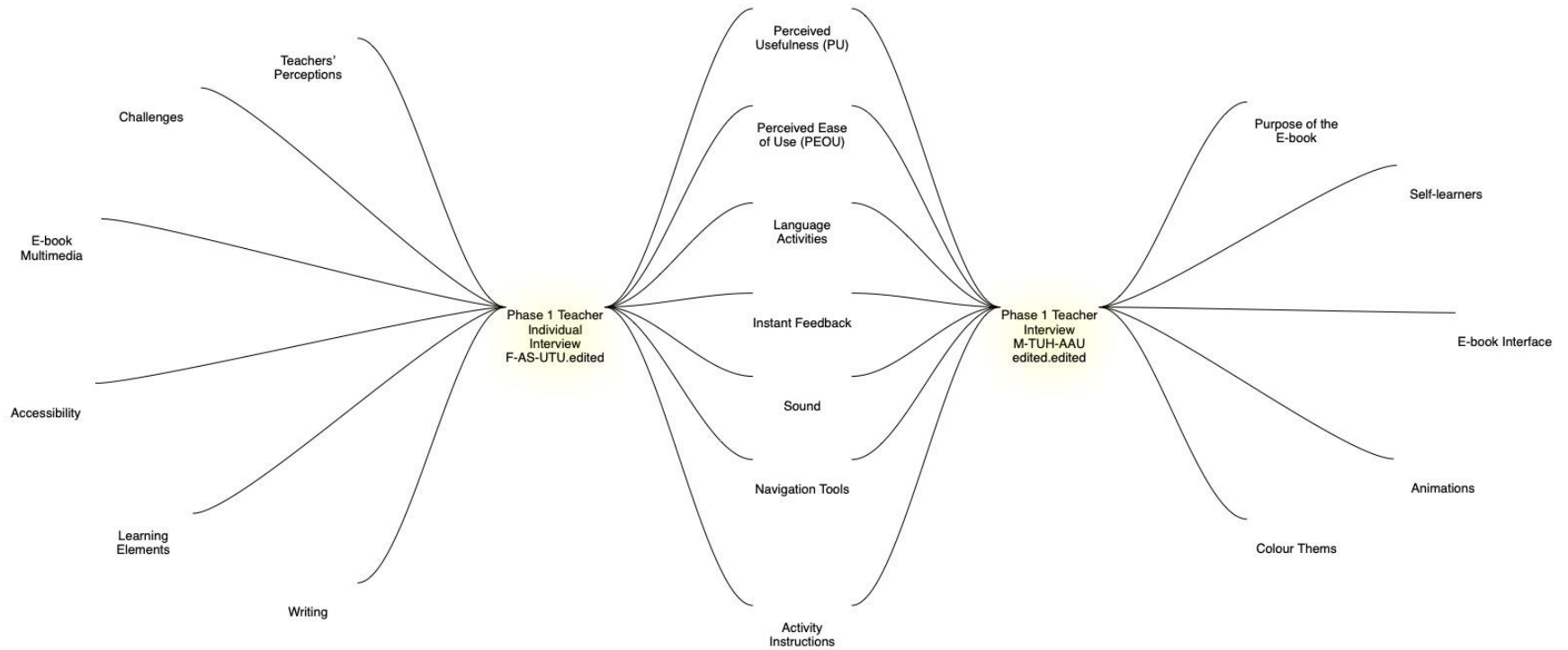
Signature of Researcher /person taking the consent _____ Date: _____ Day/month/year

One copy of this form will be given to the participant, and the original will be kept in the files of the researcher at Lancaster University

Appendix 8 NVivo comparison of Students Focus Groups (Cycle 2)



Appendix 9 NVivo Semi-Structured Interviews with Teachers (Cycle 2)



Appendix 10 Cycle 3 -Survey Items -Students

Cycle 3: Quantitative Research Questions: Students

On a scale of 1 to 5, how strongly do you agree with the statements:

1= Strongly Agree 2= Agree 3= Undecided 4= Disagree 5= Strongly Disagree

Perceived Usefulness:

1. The Alif Ba'a e-book was useful in helping me practice how to *write* the Arabic alphabet.
2. The Alif Ba'a e-book was useful in helping me practice how to *pronounce* the Arabic alphabet.
3. The Alif Ba'a e-book helped me *retain* the Arabic alphabet better than other learning methods.
4. Using the Alif Ba'a e-book improved my ability to practice *reading* isolated words in Arabic.
5. Using the Alif Ba'a e-book improved my ability to practice *writing* isolated words in Arabic.
6. The *audio* content in the Alif Ba'a e-book was useful for practising the Arabic alphabet.
7. The *examples* provided in the Alif Ba'a e-book for learning the Arabic Alphabet were helpful.
8. The Alif Ba'a e-book *motivated* me to practice learning the Arabic alphabet.
9. The *instant feedback* helped me practise the reading and writing of the Arabic Alphabet.
10. *Overall*, the Alif Ba'a e-book was useful to me in practising the Arabic alphabet.

Perceived Ease of Use:

1. I found the Alif Ba'a e-book easy to use, thanks to the *layout and design*.
1. The *instructions* provided in the Alif Ba'a e-book were clear and easy to follow.
2. The *navigation* of the Alif Ba'a e-book was logical and user-friendly.
3. *Accessing* the Alif Ba'a e-book on my device was easy.
4. *Completing assignments* on the Alif Ba'a e-book was easy.
5. *Navigating* through the interactive activities of the Alif Ba'a e-book was easy for me.
6. *Submitting assignments* via the Alif Ba'a e-book was easy.
7. I am *confident in using* the Alif Ba'a e-book to learn the Arabic Alphabet.
8. *In general*, I find it easy to use the Alif Ba'a e-book.

Intention to Use:

1. Assuming that I have access to e-books for learning Arabic, I *intend to use* them.
2. I *recommend* the Alif Ba'a e-book for learning the Arabic Alphabet to others.

Convenience:

1. The Alif Ba'a e-book was *convenient for me* to practice reading and writing the Arabic Alphabet.

-
-
2. The Alif Ba'a e-book *saved me time and effort* compared to practising learning the Arabic Alphabet compared to other learning resources.
 3. I found practising learning the Arabic Alphabet using the Alif Ba'a e-book an *enjoyable experience*.
 4. The Alif Ba'a e-book was accessible to me *anytime and anywhere*.
 5. The Alif Ba'a e-book was consistent with *my learning goals and objectives*.
 6. The content of the Alif Ba'a e-book suited *my learning needs and style*.
 7. Completing the interactive activities was *challenging*.
 8. Overall, the Alif Ba'a e-book *met my expectations* for learning the Arabic alphabet well.

Compatibility:

1. The Alif Ba'a e-book was compatible with *my existing technological knowledge and skills*.
2. The Alif Ba'a e-book was *in line with my learning preferences and habits*.
3. The Alif Ba'a e-book *complements other resources and tools I currently use* to learn Arabic.
4. The Alif Ba'a e-book was compatible with *the operating system*.
5. The Alif Ba'a e-book was compatible with *my device*.
6. Overall, I was satisfied with the *compatibility* of the Alif Ba'a e-book.

Media Richness:

1. The media in the Alif Ba'a e-book was rich in terms of *visual and audio aids*.
2. The Alif Ba'a e-book was *visually appealing* for me to practice the Arabic Alphabet.
3. The *interface* of the Alif Ba'a e-book was user-friendly.
4. The *audio quality* (clarity and pace) in the Alif Ba'a e-book was useful for practising the Arabic alphabet.
5. The *animation and GIFs quality* (clarity and pace) in the Alif Ba'a e-book was useful for practising the Arabic alphabet.
6. The media in the Alif Ba'a e-book were *engaging and interactive*.
7. The media in the Alif Ba'a e-book were *diverse and varied*.
8. The media in the Alif Ba'a e-book were *relevant to my Arabic language level*.
9. On the whole, I was satisfied with the *media richness* of the Alif Ba'a e-book.

E-book Interactivity:

1. The interactive activities in the *"Practice" section* of the Alif Ba'a e-book were effective in helping me learn the Arabic Alphabet.
2. The interactive activities in the *"Produce" section* in the Alif Ba'a e-book were effective in helping me learn the Arabic Alphabet.
3. Using the *interactive activities* in the Alif Ba'a e-book to learn the Arabic Alphabet was *enjoyable*.
4. The *interactive activities* in the Alif Ba'a e-book were *engaging*.
5. Overall, I was satisfied with the **Interactivity** of the Alif Ba'a e-book.

Appendix 11 Cycle 3 -Survey Items -Teac

Cycle 3: Quantitative Research Questions: Teachers

On a scale of 1 to 5, how strongly do you agree with the statements:

1= Strongly Agree 2= Agree 3= Undecided 4= Disagree 5= Strongly Disagree

Perceived Usefulness:

- 1) The Alif Ba'a e-book is useful in helping my students practice how to *write* the Arabic alphabet.
- 2) The Alif Ba'a e-book is useful in helping my students practice how to *pronounce* the Arabic alphabet.
- 3) The Alif Ba'a e-book helped my students *retain* the Arabic alphabet.
- 4) Using the Alif Ba'a e-book *improved* my students' abilities to *read* isolated words in Arabic.
- 5) Using the Alif Ba'a e-book *improved* my students' ability to *write* isolated words in Arabic.
- 6) The *audio content* in the Alif Ba'a e-book was useful in helping my students practice the Arabic alphabet.
- 7) The *examples* provided in the Alif Ba'a e-book for learning Arabic Alphabet are helpful.
- 8) The Alif Ba'a e-book *motivated* my students to practice learning the Arabic alphabet.
- 9) The *instant feedback* helped my students practice reading and writing the Arabic Alphabet.
- 10) *Overall*, the Alif Ba'a e-book was useful to my students in practising the Arabic alphabet.

Perceived Ease of Use:

1. Thanks to the *layout and design*, I found the Alif Ba'a e-book easy to use.
2. The *instructions* provided in the Alif Ba'a e-book are clear and easy for my students to follow.
3. The *navigation* of the Alif Ba'a e-book is logical and user-friendly.
4. *Accessing* the Alif Ba'a e-book on my students' devices is easy.
5. *Completing assignments* on the Alif Ba'a e-book was easy for my students.
6. *Navigating* through the interactive activities of the Alif Ba'a e-book was easy for my students.
7. The *examples* provided in the Alif Ba'a e-book for learning the Arabic Alphabet are helpful for my students.
8. *Assigning homework* via the Alif Ba'a e-book was easy.
9. My students were *challenged* by completing the interactive activities in the Alif Ba'a e-book.
10. *Generally*, it was easy for my students to use the Alif Ba'a e-book.

Intention to Use:

1. Assuming that I have access to the Alif Ba'a e-book for teaching Arabic, *I intend to use them*.
2. I *recommend* the Alif Ba'a e-book for learning Arabic Alphabet to others.
3. I see a *lot of value* in using the e-book for teaching the Arabic Alphabet.

Convenience:

1. The Alif Ba'a e-book made it *more convenient* for me to use technology to teach the Arabic Alphabet.
2. The Alif Ba'a e-book *saved me time and effort* compared to other learning methods.
3. The Alif Ba'a e-book is accessible to me at *any time and place*.
4. I am *satisfied* with the overall *content* of the Alif Ba'a e-book for teaching the Arabic Alphabet.
5. The Alif Ba'a e-book is consistent with *my teaching goals and objectives*.
6. The content of the Alif Ba'a e-book suited *my teaching needs and style*.
7. Overall, the Alif Ba'a e-book *met my expectations* for teaching the Arabic alphabet well.

Compatibility:

1. The Alif Ba'a e-book is compatible with *my existing technological knowledge and skills*.
2. The Alif Ba'a e-book is in line with *my teaching preferences*.
3. The Alif Ba'a e-book *complements other resources and tools* I am currently using.
4. The Alif Ba'a e-book was compatible with *my device and operating system*.

Media Richness:

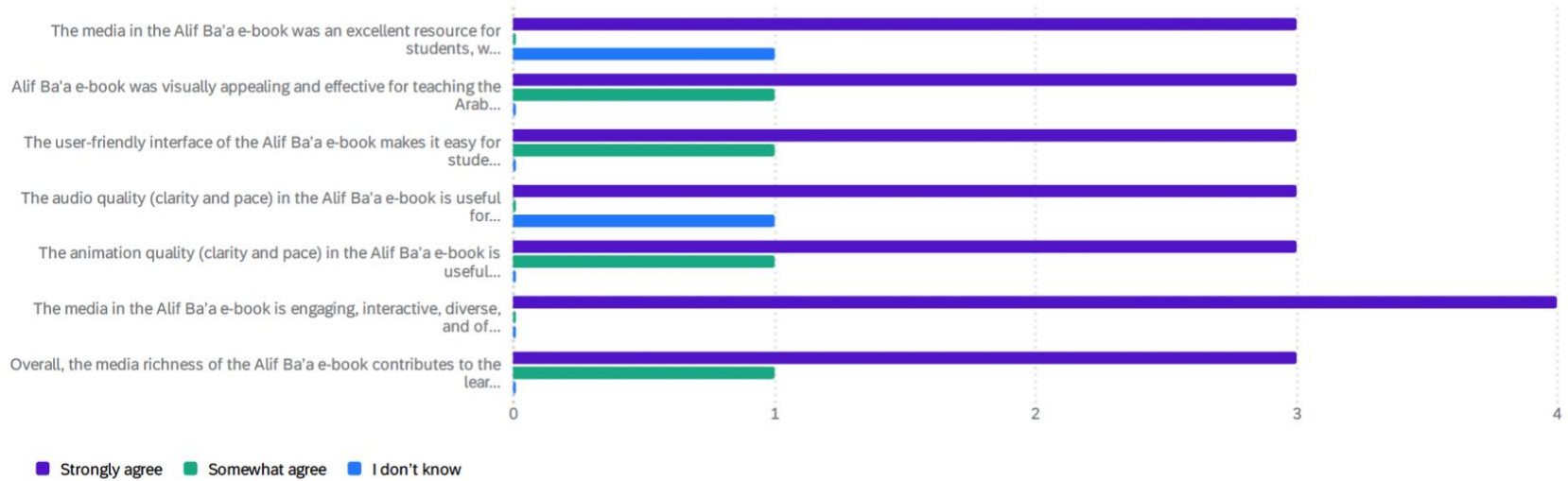
1. The media in the Alif Ba'a e-book was an *excellent resource* for students, with various *visual and audio aids* to enhance their learning experience.
2. Alif Ba'a e-book was *visually appealing and effective* for teaching the Arabic Alphabet.
3. The *user-friendly interface* of the Alif Ba'a e-book makes it easy for students to navigate and learn.
4. The *audio quality* (clarity and pace) in the Alif Ba'a e-book is useful for teaching the Arabic alphabet.
5. The *animation quality* (clarity and pace) in the Alif Ba'a e-book is useful for teaching the Arabic alphabet.
6. The media in the Alif Ba'a e-book is *engaging, interactive, diverse, and of high quality*, making it a relevant resource for teaching.
7. Overall, *the media richness* of the Alif Ba'a e-book contributes to the learning experience for students.

E-book Interactivity:

1. The interactive activities in the *"Practice" section* of the Alif Ba'a e-book are effective in helping students practice the Arabic Alphabet.
2. The interactive activities in the *"Produce" section* of the Alif Ba'a e-book are effective in helping students practice the Arabic Alphabet.
3. Using the interactive activities in the Alif Ba'a e-book to teach the Arabic Alphabet was *enjoyable*.
4. Using the interactive activities in the Alif Ba'a e-book is *engaging for students*.
5. *Overall*, the Alif Ba'a e-book is interactive for teaching the Arabic Alphabet.

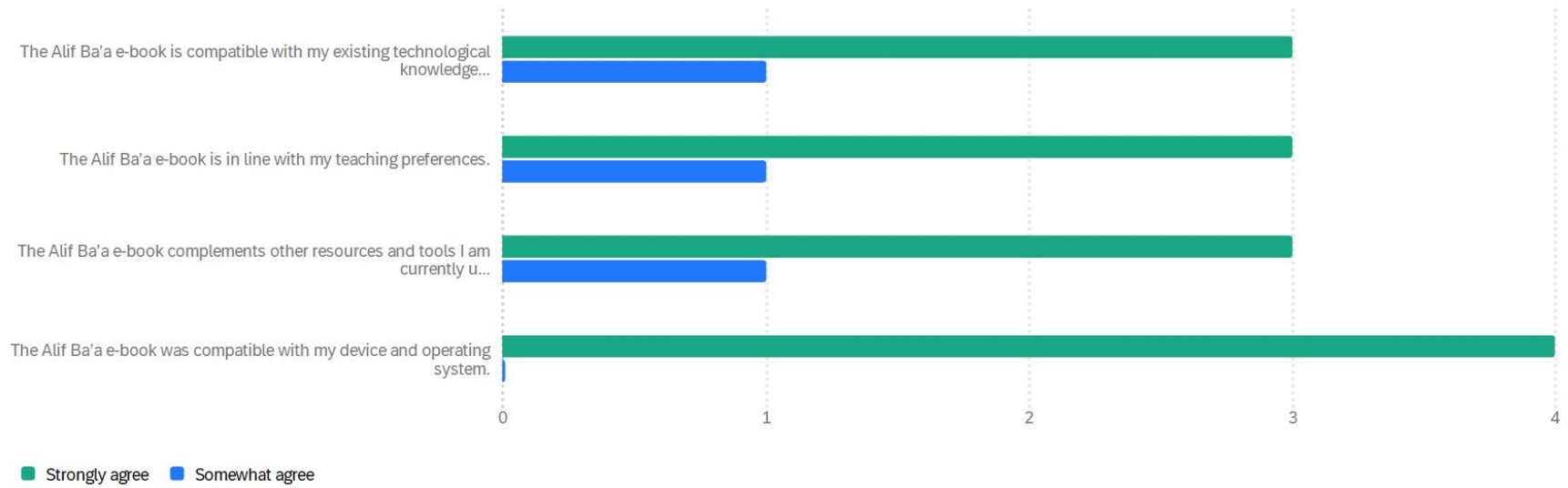
Appendix 12 A: Online Questionnaire- Teachers' Responses

Media Richness: To what extent do you agree or disagree with the following statements? 4 ⓘ



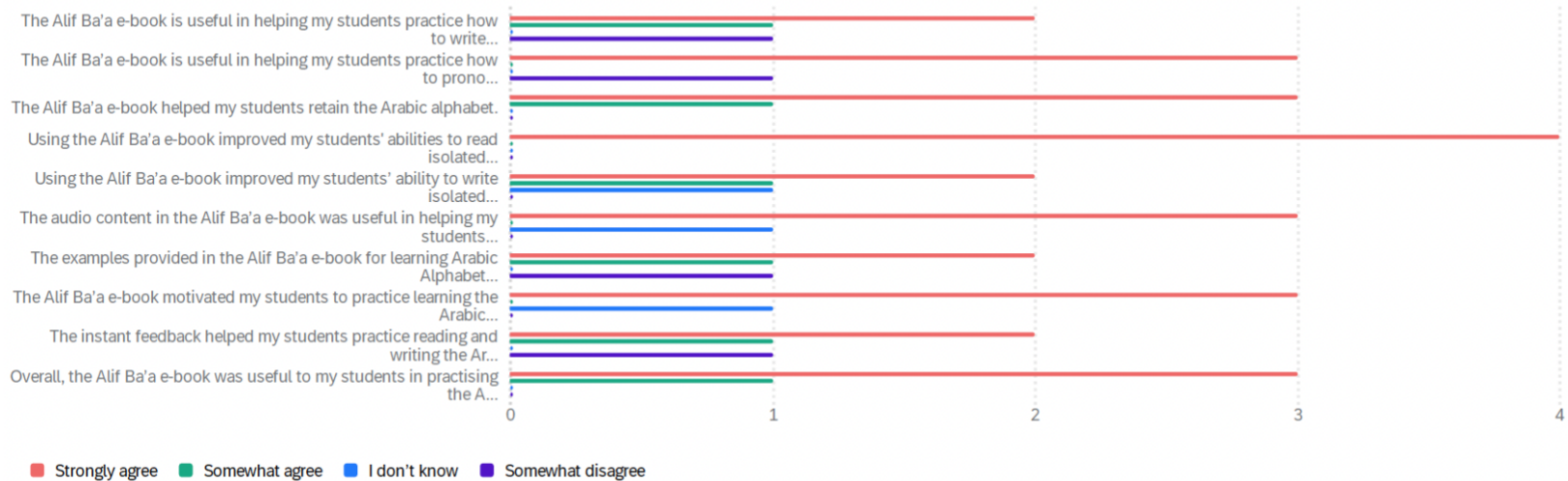
Appendix 12 B: Online Questionnaire- Teachers' Responses

Compatibility: To what extent do you agree or disagree with the following statements? 4 ⓘ

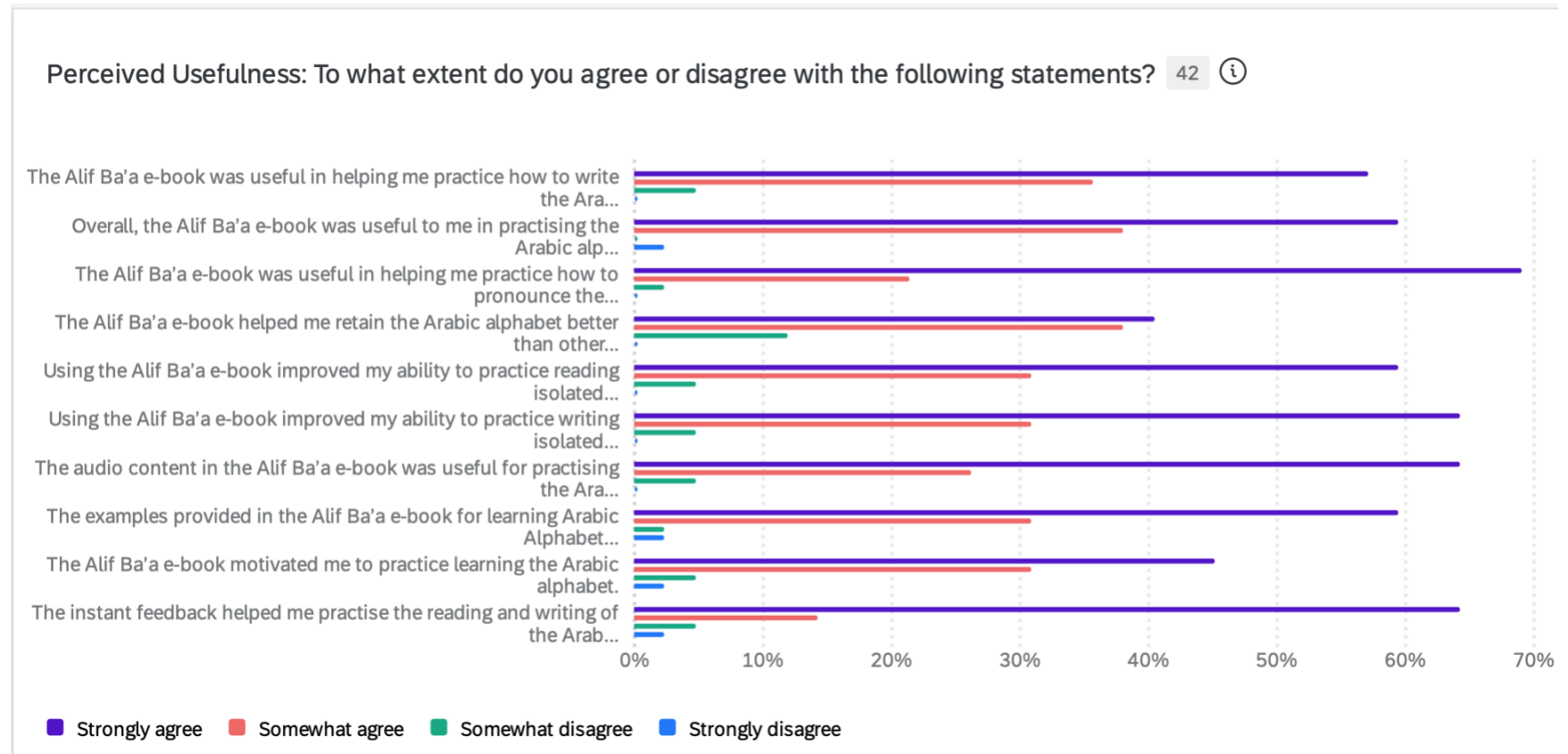


Appendix 12 C: Online Questionnaire- Teachers' Responses

Perceived Usefulness: To what extent do you agree or disagree with the following statements? 4 ⓘ

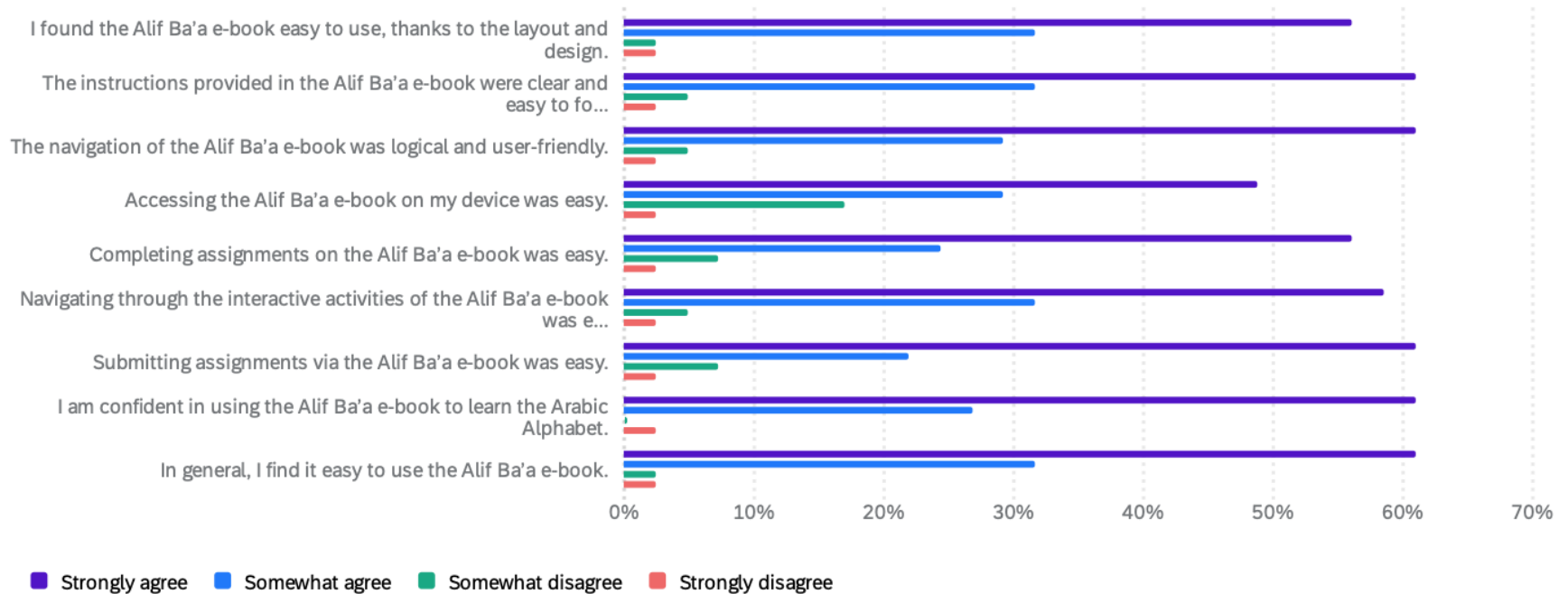


Appendix 13 A: Online Questionnaire- Students' Responses



Appendix 13 A: Online Questionnaire- Students' Responses

Perceived Ease of Use: To what extent do you agree or disagree with the following statements? 41 ⓘ



Appendix 13 C: Online Questionnaire- Students' Responses

Intention to Use: To what extent do you agree or disagree with the following statements? 41 ⓘ

