Spring 2-27-2024

Software Developers' Experiences with CALL in the Context of the Four Language Competencies (Reading, Writing, Listening, and Speaking) and Teacher and Learner Fit: A Qualitative Descriptive Study

Artem Kalyanov
akalyano@mail.umassglobal.edu

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A Dissertation by

Artem Kalyanov

University of Massachusetts Global

Irvine, California

School of Education

Submitted in partial fulfillment of the requirements for the degree of

Doctor of Education in Organizational Leadership

February 2024

Committee in charge:

Carol Anderson-Woo, Ed. D., Committee Chair

George Giokaris, Ed.D.

Marilou Ryder, Ed.D.

University of Massachusetts Global

A Nonprofit Affiliate of the University of Massachusetts

Doctor of Education in Organizational Leadership

The dissertation of Artem Kalyanov is approved.

Carol Anderson-Woo, Dissertation Chair

Carol Anderson-Woo, Ed. D.

George Giokaris, Committee Member

George Giokaris, Ed.D.

Marilou Ryder, Committee Member

Marilou Ryder, Ed.D.

Patrick Ainsworth, Associate Dean

Patrick Ainsworth, Ed.D.

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ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to the University of Massachusetts Global, the School of Education, for providing me with the resources and support necessary to complete this dissertation. I am sincerely thankful to Dr. Jeffrey Lee for the guidance and mentorship provided to me as my dissertation chair for the first three chapters of this dissertation. Thank you for our numerous online meetings and the invaluable input.

Due to unforeseen circumstances, Dr. Carol Anderson-Woo took over as the dissertation committee chair and guided me through chapters four and five. Thank you, Dr. Anderson-Woo, for your thorough feedback on my work and for your immediate availability. It was my immense pleasure working with you. I also want to thank my dissertation committee members, Dr. George Giokaris and Dr. Marilou Ryder, from whom I learned a lot as my instructors for leadership-related classes and as research advisors.

Another person who assisted me throughout my dissertation journey is Rebekka Helford; I am thankful for her invaluable expertise and dedication in editing this dissertation. Her meticulous attention to detail and insightful feedback have greatly enhanced the quality of this work, and I am genuinely thankful for her contributions.

I also want to acknowledge my family: My mother, Tatiana Kalyanova, who instilled in me the profound value of education and has been an unwavering source of inspiration throughout this journey, and my dear brother, Arthur Kalyanov, who has always been an inspirational force for me, showing what successes hard work can lead to.

Although my father, Vitaliy Kalyanov, is no longer with us, I feel his presence and guiding influence as I pursue my academic endeavors.

Finally, I am immensely grateful to my wife, Anna Manukyan, and her family for their unwavering support, understanding, and patience throughout the countless hours dedicated to this dissertation. Their encouragement and belief in me have been a driving force and a source of strength.

Thank you to all who have contributed, big or small, to this significant milestone in my academic career.

ABSTRACT

Software Developers' Experiences with CALL in the Context of the Four Language Competencies (Reading, Writing, Listening, and Speaking) and Teacher and Learner Fit: A Qualitative Descriptive Study

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Purpose: The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking, along with teacher and learner fit.

Findings: The analysis of the collected data revealed six key findings that shed light on the developers' experiences. The findings related to how CALL software developers combine different language competencies; how they implement continuous testing and evaluating of key elements of the language competencies; and how they ensure the development of a CALL program that is both effective and efficient.

Conclusion: Based on the findings and literature, six conclusions were drawn, including that CALL software developers need to be knowledgeable about learners' needs for their target audience, they should utilize assessment guidelines to standardize practices, and they should consult with language educators as they develop programs.

Recommendations: Based on the findings of this study, the researcher recommends further research in the area of CALL software developers' experiences in order to expand the understanding and knowledge of the subject matter through: (a) mixed research methods approach to obtain an in-depth understanding of how CALL software developers identify and describe their experiences with developing CALL software in the context of

the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit or (b) a case-study approach. Additionally, a similar study is recommended but focusing only on the CALL developers' experience incorporating VR and AI features in their software. This research would provide valuable insights into the development process, highlighting the complexities, successes, and lessons learned by CALL developers in integrating VR and AI features.

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CHAPTER I: INTRODUCTION

Computer-assisted language learning (CALL) refers to the use of technology to improve learners' ability to acquire the language competencies of reading, listening, writing, and speaking (Hubbard, 2006; Soleimani, 2021). Since the 1980s, educators and learners have leveraged CALL in the language learning and teaching context; the majority of language learners and instructors worldwide at all education levels use some form of CALL (Alsuhaibani, 2019; Blake & Guillén, 2020; Chapelle, 2001; Soleimani, 2021). CALL technologies have developed substantially since their emergence in the 1980s (Soleimani, 2021), including virtual, mobile, and wiki-based learning (Chen et al., 2021). Research has demonstrated that CALL engages language learners effectively and improves their learning outcomes (Arnold & Ducate, 2019; Bontogon et al., 2018; Chapelle, 2001; Chen et al., 2021; Farr & Murray, 2016; Makarenkov et al., 2019; Okonkwo, 2011).

Despite the benefits of CALL, challenges exist regarding its use in effective language learning (Gelan et al., 2018; Shadiev & Yang, 2020). The challenges are not due to the CALL technology itself but rather to a lack of educators and learner trainers regarding how to effectively utilize CALL technologies for language acquisition. To implement CALL effectively, users must be able to adjust their role as teachers or learners within the traditional classroom setting and develop the ability to use the technology in the complex language learning and teaching process (Chen et al., 2021; Soleimani, 2021). In addition to challenges in shifting their role, instructors and learners face challenges utilizing CALL software effectively due to their lack of understanding of the technology (Chen et al., 2021; Farr & Murray, 2016; Gelan et al., 2018; Makarenkov

et al., 2019; Okonkwo, 2011). In spite of evidence of challenges in the use of CALL software and barriers to the use of CALL for effective language learning, there is limited research on how CALL software is developed to help learners develop their language competencies (reading, writing, speaking, and listening). Therefore, the focus of this qualitative descriptive study was to describe how software developers create CALL software in consideration of the language competencies of reading, writing, listening, and speaking, in addition to learner and teacher fit.

As will be further described in Chapter II, although there is a substantial body of research focused on CALL, little emphasis is placed on learner and teacher fit of the CALL program in helping teachers deliver a better teaching experience while also making the learning process more accessible and more useful for the learner. Some scholars have conducted experiments to determine teacher intentions and learner outcomes with respect to CALL usage. However, there remains a shortage of studies determining CALL's learner fit and teacher fit. This gap created the basis for the current study, which described CALL software experiences by determining how software developers can design CALL programs that achieve both learner fit and teacher fit in ways that promote core language competency (reading, writing, listening, and speaking) development. This qualitative descriptive study aimed to identify and describe the experiences of CALL software developers in the context of four language competencies (reading, writing, listening, and speaking). This chapter provides an introduction to this study, including background information, the statement of the problem, the significance of the problem, definitions of terms, and study delimitations. The purpose of this chapter is to present a basic understanding of CALL, theoretical underpinnings of CALL, and the

challenges that CALL software developers face when designing CALL software for 21st-century language learners. A summary and transition to Chapter II will conclude this chapter. The next section provides an overview and background of CALL.

Language Learning Competencies

Language learning involves four main competencies: reading, writing, listening, and speaking. These four competencies are described here and will be detailed further in Chapter II.

Reading is a competency that encompasses understanding and reflecting on, and engaging with a written text. For foreign language learning, if the learner is able to read in a foreign language, they become able to interact and participate in communities where that language is primarily spoken (Georgievna, 2018). Reading competency is not a static ability; rather, it can be improved over time with appropriate instruction and practice (Wolf & Katzir-Cohen, 2001).

Writing competency is one's ability to put one's thoughts and knowledge into a meaningful written form. Writing competency allows the learner to engage with others in a foreign language through social media interaction, note-taking, writing emails, and filling out forms (Ariffin & Abdi, 2020). Writing is critical for foreign language learners because it is essential to daily communication. Moreover, writing competency allows learners to communicate their thoughts and messages to audiences in a foreign language.

Listening is a competency that encompasses one's ability to receive, interpret, attend to, process, and respond to verbal stimuli. This competency is important because it allows the learner to use verbal stimuli to supplement other social cues, such as body language, and use that information appropriately (Cheong et al., 2018). Listening

competency allows the learner to comprehend and learn new information, such as foreign language words. Listening competency involves various cognitive, affective, and behavioral components, including perception, attitude, memory, comprehension, motivation, and affective involvement, allowing the learner to receive the information openly and adjust in order to comprehend the meaning (Malushko et al., 2018).

Speaking competency, one of the essential communicative competencies, allows the individual to communicate with their environment in a new language (Lobachova, 2019). Communicative competence refers to the user's ability to effectively use the grammatical knowledge of morphology (construction of words and their relations to other words), syntax (logical order of words), and phonology (knowing how specific words sound to be able to recognize them) in a language, which allows them to communicate effectively in social interactions (Lobachova, 2019). Skills required for speaking competency include vocabulary knowledge, a good grasp of the grammar of the foreign language, appropriate pronunciation, and some moderate level of spoken fluency (that is, the ability to speak in a foreign language reasonably quickly and without having numerous hesitations (Malinovska & Feltsan, 2019). Without fluency, the learner will likely not be able to communicate effectively in a foreign language.

Language Learning and Learner-Teacher Fit

Based on the importance of context in language learning, CALL uses technology to provide a personalized experience for the learner and help instructors guide students to construct knowledge, support critical thinking, and promote better learning outcomes among their students (Chen et al., 2021; Farr & Murray, 2016; Makarenkov et al., 2019). Students have expressed perceived benefits of using CALL software programs, noting

that they serve as complementary tools in language learning (Lasagabaster & Manuel Sierra, 2003). New CALL software has been developed to support language learners in developing reading, writing, listening, and speaking competencies. Existing evidence demonstrates that most CALL programs are designed to improve only learners' reading and listening skills (Soleimani, 2021). Added to this challenge, learners and teachers experience challenges in utilizing CALL software to develop the competencies of reading, writing, listening, and speaking effectively (Tafazoli et al., 2019a, 2019b). Moreover, there is a need for further understanding of how CALL technologies can be integrated into language learning effectively, particularly as the technologies advance (Chen et al., 2021).

An important factor that is considered in CALL development is learner and teacher fit. Learner fit refers to the amount of opportunity the task presents for language engagement, which depends largely on the learner's characteristics and preferred learning styles. Learner fit, therefore, considers the learner's preferences in their language learning process. In contrast, teacher fit involves understanding what language teaching approach the software reflects to determine its compatibility with the teacher's way of teaching. Because of the intricacies inherent in human language and its interactive nature, it is important to understand how learner and teacher fit, alongside the four language learning competencies, are considered in developing CALL software.

Due to the complexity of human language and language learning, using CALL to improve the language learning experience is problematic as both learners and educators struggle to apply CALL technology effectively for language learning (Okonkwo, 2011). CALL began with the use of limited technologies and applications. However, due to the

advancement in technologies, networks, and platforms overall, CALL technologies have developed quickly to encompass a variety of technology options that can be leveraged by learners and users (e.g., mobile technologies, virtual worlds [VWs] and virtual reality [VR], digital games, computer-mediated communication [CMC], digital multimodal composing [DMC], wikis, and artificial intelligence [AI]). Due to these rapid technological developments to include various technology options, researchers have noted that CALL technologies need further investigation. Education has experienced a significant shift in recent decades that has led to the increased usage of CALL technologies (Tafazoli et al., 2019a, 2019b). Findings from past research highlighted that CALL contributed greatly to education and language learning.

There is a need for additional research on CALL in education due to the lack of understanding of how educators and learners can best use CALL in terms of language acquisition and learner and teacher fit (Chen et al., 2021). As CALL technologies become more complete, it is important to understand how software developers can create them in order to yield an effective language learning and teaching experience. Moreover, software developers face the challenge of ensuring that computer technologies meet learners' individual needs to facilitate effective language learning (Shadiev et al., 2020). The following section introduces the theoretical underpinnings for this study.

Theoretical Underpinnings: Educational Aspects of CALL

Two key models were identified to evaluate and conceptualize CALL in education and were utilized as the theoretical underpinnings for this study. Philip Hubbard's initial work was followed by Carol Chapelle, who further developed the work

of Hubbard. The following paragraphs will introduce these models, with additional detail provided in Chapter II.

Philip Hubbard (1988) was one of the key theorists to evaluate CALL software and its implications for education. Hubbard built on previous methodological frameworks for CALL software evaluation. In 2006, he redeveloped his framework, introducing a software evaluation framework under which he assumed the language learning software being evaluated according to his framework had already undergone a pre-evaluation where its suitability was predetermined. Hubbard's framework includes the following steps:

1. Technical preview: The instructor should ensure that the chosen software can run successfully on the selected equipment the learners will use.
2. Operational description: The instructor should review the main functionalities of the software to understand the flow of lessons and items and how the user will experience the software. Doing so will also help the instructor understand how the system operates, allowing them to support students' learning.
3. Teacher fit: This is one of the initial steps proposed in Hubbard's (1988) framework. This step involves understanding what language teaching approach the software reflects to determine its compatibility with the teacher's way of teaching.
4. Learner fit: The instructor should determine how well the software's content and language level are designed for the intended learners. Moreover, in this stage, the instructor should determine how well the software matches the student's preferred learning style and language interests. At the same time, the

program's difficulty and linguistic objectives should be considered in relation to the difficulty level of the language being taught.

5. Implementation schemes: This step refers to how the instructor can adopt and integrate the language-learning software into the layout of the existing curriculum.
6. Appropriateness judgments: After the instructor completes the earlier steps, they can decide whether to use the software or not, based on how well it works with the instructor, learner, and existing curriculum.

Although Hubbard (2006) did not integrate operational descriptions into the aforementioned model, he did dedicate a separate model to reviewing the components of the software to determine how well the software could be used and controlled by the user, in this case, the learner. Instructors can review the software's components to support their decision regarding whether or not to implement it in their teaching. In his original framework, Hubbard (1988) focused on presenting independent central and peripheral components of the software; however, in the updated model, Hubbard (2006) described how these components connect. The components are as follows: screen layout and interface; timing of the software; control options of the software; user input; program's procedure for managing the user's input; learner's feedback from the program; and the software's help options, which relates to the description of the content of the help, in addition to how well help is personalized at every stage.

Building on the work of Hubbard, Carol Chapelle was another prominent theorist regarding CALL software. In her model, Chapelle (2001) combined the aspects of CALL and computer-based language testing and computer-based second language acquisition

(SLA) research to conceptualize computer applications in second language acquisition (CASLA). In her model, Chapelle focuses on characterizing and evaluating CASLA and presenting its specific SLA-based criteria. She offers the following five principles that are used for assessing the suitability of CALL:

1. CALL evaluation should be situation and scenario-specific because not all CALL applications in language learning are the same.
2. The evaluation criteria of CALL should be based on SLA theory and related research.
3. CALL evaluation should be examined from two perspectives: (a) a judgmental analysis of CALL software and activities and (b) an empirical analysis of the learner's performance. Table 1 (Table 1 is presented on page 59 of this dissertation) shows three types of analysis, with Chapelle's suggested evaluand (object of evaluation), question, and evaluation type (method of evaluation) for each analysis.
4. The criteria on which a CALL evaluation is based should be applied to the relative purpose of the task.
5. Lastly, when evaluating CALL, special consideration should be placed on its teachers and learners.

Chapelle (2001) also proposed six general evaluation criteria. These criteria can help to determine the appropriateness of any CALL task in supporting learners in their language learning and language skill acquisition process. Chapelle argued that these criteria should be applied to all CALL tasks defined by the software and the instructor. These criteria are as follows:

1. Language learning potential: This criterion refers to the degree of the opportunity presented by the task, which will support the learner in developing greater focus and skills.
2. Learner fit: This criterion refers to the amount of opportunity the task presents for language engagement, which depends largely on the learner's characteristics and preferred learning styles.
3. Meaning focus: The third criterion focuses on the extent to which the learners remain attentive and focused on understanding the meaning of the language and how well the task can facilitate those abilities.
4. Authenticity: This criterion refers to the degree of correspondence between the learner's activity and the language-related activities outside the classroom that interest the learners.
5. Positive impact: The fifth criterion refers to the overall positive effect of CALL on its learners and teachers.
6. Practicality: The last criterion refers to how resources support language learning activity within CALL.

Chapelle's (2001) CALL framework is structurally quite different from Hubbard's (1988, 2006) in that it generally holds different assumptions about language learning and CALL. However, in some respects, both methodological frameworks are compatible. For instance, the concept of learner fit described in Chapelle's six general evaluation criteria can be linked back to Hubbard's model. In contrast, the remainder of Chapelle's criteria re more task-based than the principles presented by Hubbard, who focuses more on the teacher-fit approach alongside learner-fit. In this study, both models

were considered to provide theoretical framing. Chapter II presents further details regarding these models for CALL.

Statement of the Research Problem

CALL may be an essential supplementary tool for foreign language teaching and learning; however, as suggested by a substantial volume of research, CALL software implementers and developers are experiencing challenges incorporating CALL solutions in a present-day foreign language classroom so that learners can better develop the language competencies of reading, writing, listening, and speaking. Current research on CALL reveals that CALL software developers' main challenge lies in developing and implementing CALL materials that are appropriate for learners' and teachers' needs (Arneil & Holmes, 2003; Bangs, 2003; Felix, 2001). Felix (2001), Bangs (2003), and Arneil and Holmes (2003) have identified some key ideas regarding how technology should be incorporated into the classroom and some practical examples of how the new technologies can offer great potential for adding value to face-to-face teaching. Hence, the aforementioned scholars' ideas indicate a need for further investigation into how software developers consider linguistic and technical factors when developing their software to ensure learner and teacher fit, along with language competencies.

Moreover, Tafazoli and Golshan (2014) stated that all the linguistic and technical aspects of using CALL in classes should be considered when developing language software. These ideas could be developed further into a description of challenges that CALL developers face in terms of designing and sustaining quality distance language programs that aim to limit technological constraints in teaching. Thus, the trend in the

research points to a need for further investigation into the practice of working with these challenges.

Another study by Samuels (2013) revealed the experiences of CALL practitioners (language lab directors, language educators, etc.). Samuels demonstrated how CALL professionals consider some specific pedagogical aspects of CALL solutions when deciding which CALL software to use in their language labs for students. Samuel's study is seminal to the industry of CALL software developers. Yet, his findings suggest that there may be a need to further understand CALL software developers' experiences, specifically how they align with key CALL factors, such as user requirements.

Abundant research has been published on the essential element of good practice in developing and implementing CALL materials (Arneil & Holmes, 2003; Bangs, 2003; Felix, 2001). Additionally, Felix (2001), Bangs (2003), and Arneil and Holmes (2003) have identified some key ideas on how the new technologies can offer great potential for adding value to face-to-face teaching. Tafazoli and Golshan (2014) also stated that all the linguistic and technical aspects of using CALL in classes should be considered when developing language software. Moreover, despite Samuels' (2013) demonstration of how CALL professionals consider some specific pedagogical aspects of CALL solutions when deciding on which of the CALL software to use in their language labs for students, very little is known about how software developers identify and describe their experiences with developing CALL software to incorporate the four language competencies of reading, writing, listening, and speaking, along with teacher and learner fit. The language competencies and teacher and learner fit must be considered alongside technical design in developing CALL software. In addition to addressing language competencies, learner fit

and teacher fit of the CALL program must be considered because they help to deliver a better teaching experience, while also making the learning process easier and more useful for the learner.

Purpose Statement

The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit.

Research Questions

The following research questions guided this study:

1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking?
2. How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?
3. How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?

Significance of the Problem

This study investigated how CALL software developers identify and describe their experiences developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking, while also considering teacher fit and learner fit.

First, this study is significant because it focuses more on the experiences of software development. Although studies such as Mei et al. (2018) and Tafazoli et al. (2019a) investigated the types of CALL software that have been developed, little is known about the developers' experiences during the software development stage. Findings from this study would help add to the findings of researchers like Mei et al. and Tafazoli et al. because the experiences of CALL developers can contribute to the overall literature regarding CALL software development, or, more specifically, CALL software development related to the four language competences: reading, writing, listening, and speaking.

Second, this study's findings on CALL developers' experiences will better describe how CALL software developers design programs that achieve learner fit and teacher fit. The findings from this study will reveal in depth the implications that CALL software has for teachers and learners in ways that promote core language competency (reading, writing, listening, and speaking) development.

Additionally, the present study's findings will contribute to both research and practice of CALL software development in the context of the four language competencies. This research will expand on the current body of research on CALL and the four language competencies (Arnold & Ducate, 2019; Soleimani, 2021). In the following sections, definitions and delimitations are presented. Following the delimitations, an organization of the study is provided.

Definitions

- CALL Software: Computer-assisted language learning (CALL) software is a technology-based approach that enhances learners' proficiency in reading, listening, writing, and speaking language skills (Hubbard, 1988).
- CALL Software Developer: A CALL software developer is anyone involved in the process of creating a piece of CALL software, including team members and company CEOs.
- Language competency: Language competency refers to the learner's competencies in the areas of reading, writing, listening, and reading.
- Learner fit: Learner fit is the extent to which the content, language proficiency, and instructional methodology of the CALL program correspond with the skills, capabilities, learning preferences, and language preferences of the learner (Hubbard, 1988).
- Teacher fit: Teacher fit refers to the ability of comprehending what language teaching strategy is reflected or imbedded in software so that it can be compared with the teacher's own preferred methods and style (Hubbard, 1988).

Delimitations

As suggested by Roberts and Hyatt (2020), delimitations refer to the scope of a study as established by the researcher. Determining the scope of the study entails defining the study's boundaries. This study was delimited to using a qualitative methodology and descriptive research design. Additionally, the study population as limited to CALL software developers employed at various companies that provide foreign language

teaching services and have experience developing software to support language learning for more than 3 years.

Organization of the Study

This study is presented in five chapters. Chapter I presented an introduction to this study, including background information, the statement of the problem, the significance of the problem, definitions of terms, and study delimitations. Chapter II reviews the literature on CALL for language learning, challenges associated with CALL software, CALL users (learners and instructors), and software developers. In Chapter III, the methodology and design used for this study are presented, including the population, sample, and criteria for selecting participants for the study. In Chapter IV, the findings of the study are presented, including the results of the data analysis. Lastly, Chapter V provides an interpretation of the results presented in Chapter IV, along with a discussion of implications and recommendations for further research and practice. Additionally, in Chapter V, the researcher shares concluding remarks and observations.

CHAPTER II: LITERATURE REVIEW

Overview

This qualitative descriptive study aimed to identify and describe the experiences of CALL software developers in the context of four language competencies (reading, writing, listening, and speaking), along with teacher fit and learner fit. Chapter I of this study provided an introduction to this study, including background information, the statement of the problem, the significance of the problem, definitions of terms, and study delimitations. Chapter I provided a base understanding of CALL from the perspective of its development for language learning, theoretical underpinnings to understand CALL better, and the challenges that CALL software developers face when designing CALL software for 21st century language learners. This chapter presents the literature on CALL for language learning, the challenges associated with developing CALL software for language competencies, and literature on CALL users (learners and instructors) and software developers. This literature review explores published works on CALL's linguistic, technological, and educational aspects and begins with an overview of the four language competencies. The four language competencies are presented to provide a context for using CALL for language learning, followed by a brief overview of language learning and technology, along with trends in 21st century language learning. The next section focuses on the linguistic aspects of CALL and their implication for teachers/instructors, learners/users, and software developers. Then, these implications are explored in more detail while reviewing the technological aspects of CALL. The chapter continues with a comprehensive review of the educational aspects of CALL for learners/users.

Although there is a well-established body of research focused on CALL, as elucidated in this chapter, the literature review conducted for this study revealed that little emphasis is placed on learner fit and teacher fit of the CALL programs in helping teachers to deliver a better teaching experience, while also making the learning process easier and more useful for the learner. Thus, there is evidence of scholars conducting some experiments to determine teacher intentions and learner outcomes. However, there remains a shortage of studies to determine CALL's learner fit and teacher fit. This gap created the basis for the current study, which sought to determine how software developers can design CALL programs that achieve both learner fit and teacher fit in ways that help promote the development of core language competencies (reading, writing, listening, and speaking).

As for the research strategy used in conducting this review of the literature, the researcher focused on conducting the literature search in major scholarly databases (i.e., Google Scholar, Scopus, Web of Knowledge, JSTOR, Science Direct, and Directory of Open Access Journals) due to their accessibility and availability of resources. The researcher focused primarily on peer-reviewed literature, meaning that other scholars in the field reviewed the articles before publishing. The researcher focused on recent literature because computer-assisted learning is a recent phenomenon. Thus, most of the articles used in this chapter were published between 2018-2022, except for earlier seminal works. The researcher included both qualitative and quantitative studies.

The Four Competencies

Four main competencies are involved in language learning: reading, writing, listening, and speaking. This section focuses on the specific aspects of these

contributions. The four main competencies involved in language learning are key to the presentation of the literature on the use of CALL for language learning. Each competency will be presented in the four respective subsections to follow.

Reading

Reading is a competency that encompasses understanding and reflecting on and engaging with a written text. Reading allows readers to develop their knowledge and learning potential, thus increasing their participation in society. In the context of foreign language learning, if the learner is able to read in a foreign language, they become able to interact and participate in communities where that language is primarily spoken (Georgievna, 2018). When learning how to read, the individual develops their phonemic awareness, which allows them to recognize individual sounds in spoken words and apply that knowledge to written words. Concerning reading, there are five main skills required for success: phonemic awareness (ability to combine syllables and words into a cohesive meaning), knowledge of vocabulary, knowledge of sentence construction (syntax), spelling, and reading fluency (Kim & Piper, 2019). The process of learning how to read in a second language is a different process than learning to read in one's native language (Koda, 2007). For instance, if the individual learns to read in a language that uses the same alphabet, they need to adapt their phonemic awareness in that language and apply it to reading. However, if the individual learns to read in a language that uses a completely different alphabet or writing system, their entire reading competence needs to be changed, and the core five skills need to be relearned in the new language. Although reading is not as critical as listening and speaking when engaging in a foreign language, it is a competence that helps people engage and participate meaningfully in society.

Writing

Writing competency refers to one's ability to express one's thoughts and knowledge in a meaningful written form. This competency allows the learner to interact mentally with written text in a clear and meaningful way. The skills required for comprehensive writing overlap with those required for reading (i.e., knowledge of proper spelling and punctuation, good word usage and vocabulary, knowledge of appropriate paragraph and sentence structure, and the ability to edit and rewrite). Having a competence in reading can significantly help with acquiring competency in writing in a foreign language (Kafipour et al., 2018). To develop this skill effectively, the learner must be able to exercise their cognitive structures, representing their thoughts in a foreign language. Consequently, for written competency development in a foreign language, the learner must possess a sufficient level of grammatical knowledge, phonemic awareness, knowledge of vocabulary, knowledge of sentence construction, spelling, and reading fluency, which may be a more challenging and time-intensive process when learning a second language through CALL (Alamri, 2016). Writing competency allows the learner to engage with others in a foreign language through social media, note taking, writing emails, and filling out forms (Ariffin & Abdi, 2020). Ultimately, writing is an important skill for foreign language learners because it serves as an important part of daily communication. Moreover, writing competency allows learners to communicate their thoughts and messages clearly and address different audiences adequately.

Listening

Listening is a competency that encompasses one's ability to receive, interpret, attend to, process, and respond to verbal stimuli. This competency is important because it

allows the learner to use verbal stimuli to supplement other social cues, such as body language, and use that information appropriately (Cheong et al., 2018). Listening allows the learner to comprehend and learn new information, such as new foreign language vocabulary. The learner is then able to critically evaluate the information that they have received and respond appropriately. Skills that are important for this competency include attention, attitude, and adjustment. However, an important aspect of listening competency is the learner's competence in the sound system and phonemic awareness of the spoken language (Yilmaz, 2012). With this skill, even though some words may appear to sound different, the learner can still recognize that they have a specific meaning. Attention allows the learner to extract and retrieve relevant information, attitude allows the learner to receive the information openly, and adjustment allows the learner to comprehend the meaning (Malushko et al., 2018). Attention is an essential skill for foreign language learning because without it, learners are unable to receive, retrieve, and store new information that subsequently becomes knowledge.

Speaking

The last competency refers to the learner's ability to have a conversation with another person in a foreign language. Speaking competency, as one of the essential communicative competencies, allows the individual to communicate with their environment in a new language. Communicative competence is typically developed in one's native language, enabling the speaker to use the language appropriately in any situation. Communicative competence refers to the user's ability to effectively use the grammatical knowledge of morphology (construction of words and their relations to other words in the language), syntax (logical order of words), and phonology (knowing how

specific words sound to be able to recognize them), enabling them to communicate effectively in social interactions. This competency means the learner can have interactive and mutual interactions with other speakers of the same language, enabling them to participate in the new culture (Lobachova, 2019). This also means that the learner must possess adequate listening and speaking competencies to form meaningful interactions in the foreign language. Speech is important in foreign language learning because it allows the learner to convey information effectively, share knowledge, and persuade or motivate another person. Skills required for this competency include vocabulary knowledge, a good grasp of the grammar of the foreign language, appropriate pronunciation, and a moderate level of spoken fluency (that is, the ability to speak in a foreign language reasonably quickly and without having prolonged hesitations (Malinovska & Feltsan, 2019). Without fluency, the learner will likely not be able to communicate effectively in a foreign language.

Overview of Learning in 21st Century: Language Learning and Technology

Before discussing CALL's linguistic, technological, and educational factors, it is important to review the history of language learning education and technology and the emergence of CALL in language learning. This section begins with a brief introduction to the history of technology in language learning. Subsequently, the section will describe the evolution of CALL and its applications to foreign language learning with technological developments in the 21st century.

History of Technology in Language Learning

The use of technology in foreign language learning started around the same time technology was first introduced in education. Ever since audio recording technology was

introduced, learners were able to learn a foreign language independently by listening to recordings of the desired language in addition to their guided instruction. Taruskin (2006) noted that the first foreign language audio recordings was produced in the early 19th century. Audio recordings allowed language learners to add an acoustic element to textbooks, which was the traditional language learning method at the time. These recordings made a substantial contribution to language learning, because students were able to further develop their listening and speaking skills, two of the core language competencies. Learners were able to store the recordings and engage in self-study with the help of these recordings, as well as practice different dialects and sociolects (i.e., dialects associated with a social class). This method allowed learners to imitate native speakers, when possible, as well as record their own attempts at speaking the foreign language and compare them with the recording. Although audio recorders were not strictly considered technological devices, this language-learning method was highly advanced at the time.

Language learning methods began to change with the introduction of more sophisticated technology, such as computers. In the 1960s, computer-like devices were initially introduced in language learning. Computer-like devices allowed language learners to engage in an audio-lingual learning method, where learners were able to engage in online speech and listening exercises (Kannan & Munday, 2018). Initially, these exercises consisted simply of imitation exercises using pattern drills (Taruskin, 2006). Although this was a significant improvement from the static learning method of audio recording, it also meant that many language learners were exposed to a rigid learning arrangement that did not promote their creativity or engagement.

Technology began to improve in the 1970s, leading new methods of language learning to emerge. In 1970s, analogue media networks began to be introduced in classrooms. Analogue media networks initially consisted of cassettes, overhead transparencies, and television (Taruskin, 2006). With these technologies, language learners had greater access to different types of information; however, these technologies did not promote a useful learning arrangement for language learning because it offered a limited opportunity for practice and dialogue; instead, the student was faced with yet another recording sample in another language (Kannan & Munday, 2018). Even so, introduction of these technologies meant that language learners were exposed to different forms of digital communication and multimedia, which was a new advancement for language learning (Taruskin, 2006). Unfortunately, these technologies still lacked in the dimension of learner autonomy, which enables learners to take charge of their own language learning.

Over time, technology has been adopted more commonly for educational purposes, as opposed to the purposes for which it was initially introduced (i.e., increased efficiency, innovation, information-sharing, and productivity). With many of the recent advances in technology related to telecommuting and remote environments, technology has begun to be applied in education in general for many decades. For instance, Kay and Goldberg (1977) introduced a device for educational purposes that resembled today's mobile devices. Over time, similar devices such as the Palm Pilot began to be popular in the common market in the 1990s (Bernacki et al., 2021). However, in the early 21st century, mobile devices began to gain popularity, consequently garnering the attention of consumers and learners alike (Laouris & Eteokleous, 2005). Their growing popularity

was associated with the fact that learning had shifted from being learner-centered (directed primarily by the educator) to learner-driven (directed primarily by the learner). These advances meant that learners were able to take responsibility for their own learning by focusing on their own goals with some guidance from the educator. Mobile learning also meant that learners were able to learn at their own speed, which increased their engagement and motivation to complete the learning (Bernacki et al., 2021). Ultimately, mobile devices contributed significantly to the world of learning.

Trends in 21st Century Learning in General

The world of education and learning has changed significantly in the last century. Informational technology is the driving force behind many educational reforms because it promotes knowledge-sharing and learning in a way that could not be done previously by creating a digital environment and record as well as ensuring that absent students are able to acquire lesson materials (Burbules et al., 2020). Nowadays, classrooms and education institutions are shifting away from traditional learning methods and classroom-only learning (Louw et al., 2016)). The recent advancements of AI, the Internet of things (IoT), and big data have made learning more accessible and dynamic. Learners now have access to large volumes of real-life knowledge that is being constantly updated (Burbules et al., 2020; Cioffi et al., 2020). In the 21st century, trends in learning have significantly become more technology- and computer-based.

These technological advances have brought about new trends in learning. In recent decades, the world of education shifted toward focusing on the individual learner acquiring 21st-century skills to improve their competency in the labor market (Blake & Guillén, 2020). This trend means that learning and education shifted to offer skills that

allowed learners to become more strategic, creative, and analytical (Mula et al., 2017). Other scholars have identified the four Cs of learning in the 21st century: creativity, communication, critical thinking, and collaboration. Similarly, these skills enable learners to critically assess the information they are learning or accessing, engaging with new forms of communication on different learning platforms, increasing their literacy and fluency levels, and improving collaboration (Burbules et al., 2020). Ultimately, these skills and competencies are designed to allow learners to become more flexible in the ever-changing and evolving world of work.

Learners in the 21st century are seeking alternatives outside of formal education and learning. Blake and Guillén (2020) highlighted emerging changes as classrooms shift toward 21st century technology at educational institutions and organizations. Although many higher education institutions in America have started to offer online materials and online versions of their programs, many Americans still desire additional or alternative online courses to improve their knowledge (de Castell et al., 2014). Higher education institutions continue to offer traditional learning that is more learner-centered as opposed to learner-driven (Burbules et al., 2020).

Despite the status quo, there has been significant growth in the use of virtualization and visualization technologies, which offer learners a sensory learning environment that stimulates and engages them. Similarly, implementing elements of gaming into traditional learning spaces is increasingly common, due to growing evidence of increased engagement and motivation in learners as a result of virtual, auditory, and visual stimuli (Burbules et al., 2020). Ultimately, in the 21st century, learners prioritize learning methods that are engaging and stimulating, are rich in visual and auditory

stimuli, and promote critical skills for life and employment. Understanding the history of technology in education that has laid the foundation for virtual learning today is critical to unpacking the development process for CALL software.

Along with the development of mobile devices, technology has become more advanced. One such example is AI and machine learning. AI refers to a group of systems that are able to perform tasks that require an element of human intelligence (Adamopoulou & Moussiades, 2020). Machine learning is used to assist AI systems, because it employs algorithms that allow the systems to learn from and make predictions on data, without being explicitly programmed. Although AI and machine learning are broad topics in technology, these technologies have been applied in learning over time. AI was developed initially in the 1960s to create a chatbot interface, i.e., a human-computer interaction defined as a program that can simulate conversation with human users (Adamopoulou & Moussiades, 2020). Chatbots were soon able to mimic humans in their interactions. Although initially, chatbots were introduced for medical and psychiatric purposes (Brandtzaeg & Følstad, 2017), their first applications in the educational context were observed in 2001, when the chatbot called "SmarterChild" was developed to support people with practical daily tasks of retrieving information regarding scores, news, or databases (Adamopoulou & Moussiades, 2020). Over time, smart personal voice assistants that responded to voice commands began to be built into networked home and mobile devices. These voice assistants were able to connect to the internet and produce meaningful responses, unlike some of their predecessors (Hoy, 2018). Thus, chatbot-turned-voice assistants began helping people retrieve old

information, collect new information, complete everyday tasks, and support users' general learning.

With the aforementioned advancements in technology came a growth in distance education (DE) and open and distance learning (ODL). As technology improved, these approaches to learning began to evolve and improve, providing new opportunities to learners. Historically, DE initially emerged in instances where learning content or course materials were delivered by mail, allowing individuals to undergo *home study* by learning the materials while being away from a place of study. This offering became increasingly popular in American universities in the 20th century, particularly during World War II (Bozkurt, 2019). Several decades later, the late 1980s and 1990s witnessed a growth in communication satellites and educational television, which became increasingly more accessible to American residents (Saba, 2013). The growth of educational television meant that many learners could access and learn new information from home. Finally, computer-based DE emerged in the late 1990s and early 2000s, enabling universities and other institutions to transition to online campuses where learners could guide their own learning (Bozkurt, 2019). These advancements included mobile learning and e-learning, which exposed learners to interactive visual and auditory learning content that not only was stimulating and engaging but also motivated learners to guide their own learning (Saba, 2013). These advancements gave rise to what is known today as *computer-assisted learning*.

Technology has created a significant shift in learning today. According to Bernacki et al. (2021), mobile learning allowed people to become more engaged in their learning process, improving their information recall and knowledge retention. Bernacki et

al. (2021) linked this phenomenon to psychology, arguing that being able to learn flexibly, around one's own schedule, and according to one's ability level enables learners to be the drivers of their own learning. Moreover, Adamopoulou and Moussiades (2020) argued that learning conducted via IoT mobile, or other networked technology, affects the process and outcomes of the learning process via interactions within a digital environment or ecosystem, affords new opportunities to directly influence learning processes or outcomes, and provides opportunities to collect previously unobtainable data that improve understanding and modeling of the learning process. This technology has been implemented widely using CALL to facilitate foreign language learning.

The introduction of the internet created an even greater shift in language learning than readily available audio/visual technology found in early educational technology. The emergence of the internet in the 1990s meant that technology was able to address the previous challenges faced by language learners, such as self-assessment, self-practice, and the ability to self-manage their own learning (Reinhardt, 2018). The internet's growth of popularity in education created more opportunities for language learning. According to Reinhardt (2018), by the 21st century, technologies such as VR, augmented reality, cloud computing, and computational thinking had improved the level of instruction and practice for language learners, leading to a significant improvement in language learning. The development of the internet's learning capacities also led to increased interest in the social aspects of language learning and how they can be facilitated with a digital ecosystem. With the growth of Web 2.0 technologies such as widely available online content and social media, language learners experienced greater accessibility and opportunities for social interaction, ultimately supporting their language learning

progress. Social media such as social networking websites, media technologies, and blogs meant that learners were able to share knowledge with others instantaneously (Shadiev & Yang, 2020). Ultimately, the introduction of new and emerging technologies to language learning meant that language learners had more opportunities than ever before to improve their skills.

Second Language Acquisition Theory

Second language *acquisition* differs from second language *learning*. According to S.D Krashen (1982), second language acquisition is an unconscious process of learning the second language (after the first language is already fully learned), whereas learning a second language is an active and conscious process of acquiring a new language and second language production. SLA occurs in different stages, which will be discussed subsequently.

Krashen's Theory of Second Language Acquisition

S.D. Krashen (1982) developed a theory of SLA, where he proposed five different hypotheses regarding factors that he believed contributed to the acquisition process. First, in the acquisition-learning hypothesis, Krashen distinguished between two approaches to language performance: acquisition and learning. Krashen argued that acquisition is a more natural and authentic language learning process, which can occur through direct exposure to another language. He argued that language acquisition occurs most commonly among babies, who are naturally exposed to others speaking around them in another language. Krashen also argued that second language learning is a conscious effort to seek mastery in a different language using syntax and lexis.

The language acquisition process occurs in five different stages. First, there is a silent period, where the individual is exposed to and listens to direct and indirect language input. Second, there is the early production stage, where the individual begins to produce short phrases and some words in the new language. Third, there is speech emergence, which occurs when the individual becomes able to communicate through simple sentences and words. Fourth, there is the intermediate fluency stage, where the learner becomes more advanced in their language production. The last stage is advanced fluency, when the student achieves a close to native level of language proficiency (S.DKrashen, 1982).

The next hypothesis proposed by S.D. Krashen (1982) is the natural order hypothesis. Krashen argued that there is a natural order in which the child picks up what later becomes their native language. Krashen argued that the same natural order occurs when the individual acquires a second language, naturally distinguishing between the native and the second language. Natural order helps the individual to learn one part of the language before acquiring the next, such as learning past/present/simple tenses.

The monitor hypothesis is the third hypothesis proposed by S.D. Krashen (1982). According to this hypothesis, the individual monitors their own language progression, doing regular self-checks and self-corrections. The monitoring occurs through listening to others speaking in that language and understanding the new language's rules. However, this is the more conscious stage than the previous two, because it requires the learner to remain focused on their own use of language and learn about language rules in the first place.

The fourth hypothesis is the input hypothesis (S.D. Krashen, 1982). During this stage, the learner realizes that they require a greater language exposure in order to advance their existing language levels. If not enough exposure occurs, the learner will likely stay on the same level with little to no improvement. If there is an imbalance in language input, i.e., the learner produces more language than they are exposed to, it may lead to anxiety and mistakes while learning.

The last hypothesis by S.D. Krashen (1982) is the affective filter, which includes several affective variables that contribute to SLA, such as motivation, self-confidence, and anxiety. The affective filter theory suggests that the emotional state of the language learner is a vital factor in acquiring a second language. Optimal language acquisition settings occur when learners possess high levels of confidence and drive, resulting in a low emotional filter. During this stage, learners exhibit a heightened receptiveness to new information, which aids in acquiring and developing language skills. If the learner does not reach this stage, they are likely to experience more anxiety and stress in relation to their language learning, language production, and the quality of their output.

Additional Hypotheses of Second Language Learning

Interaction Hypothesis. Michael Long (1980, 1985) proposed that language proficiency is developed through interaction and communication. Communication and face-to-face interaction are important in order to provide input for the learner. As learners process inputs, they are able to improve their comprehension and ability to comprehend and modify their language in their responses. Like other scholars, Long's interaction hypothesis emphasizes inputs for language learning.

The Output Hypothesis. Merill Swain developed a theory surrounding the output hypothesis. Swain and Lapkin (1995) suggested that meaningful output in language learning is as important as meaningful input. The output functions are noticing, hypothesis testing, and metalinguistic functions. Each function demonstrates that the learner understands that they have encountered a gap must change their output in response (Swain & Lapkin, 1995). According to the output hypothesis, language learners get advantages by generating linguistic output. The output hypothesis posits that engaging in language production, whether through speaking or writing, enhances language growth and ability. In contrast, Krashen suggested that language learners had a restricted function in terms of producing language. The input hypothesis, proposed by S. Krashen in 1981, posits that language learning is largely influenced by exposure to understandable input rather than the generation of linguistic output. Krashen asserted that learners can acquire language more efficiently via comprehending linguistic input rather than prioritizing the production of accurate output. In contrast to this claim, the comprehensive output hypothesis presented by Swain is key for language acquisition. Due to the conflict Krashen's view, the output hypothesis has been debated among scholars.

Noticing Hypothesis. In contrast to Swain, Richard Schmidt developed a theory emphasizing input. R.W. Schmidt (1990) proposed that language learners must be able to process and internalize those inputs. Learners who can recognize the inputs of language are able to incorporate or absorb those inputs for learning (R. Schmidt, 2012). Scholars have challenged the noticing hypothesis (e.g., Ellis, 2005; Gass, 1988; Truscott, 1998), questioning how input is defined and whether an input is required for learning.

Input Processing in Second Language Acquisition. Bill VanPatten (2004) developed the theory of input processing in SLA. The focus of the theory is to understand how second language learners process language input as well as the consequences of this processing. Van Patten emphasized the importance of language learning as a dynamic process that is affected by the language learner's environment. In order for language learners to acquire language, they must be given inputs to process and develop their language competencies. The input processing theory makes a contrasting emphasis to that of the output hypothesis.

Second Language Acquisition in Adults

As described by S.D. Krashen (1982) in his model, the language acquisition process can occur during both childhood and adulthood, but tends to look different during each stage. Although language acquisition is an entirely unconscious process for young children who are merely exposed to a new language, this process tends to be more conscious for adults (Febriani et al., 2021). Although children acquire a new language naturally, the process can be somewhat more conscious and less natural for adults.

Findings from previous studies suggested that the environment plays an important part of adult language acquisition. For instance, Bahruddin and Febriani (2020) found that SLA in adults was largely influenced by the language environment, the input and processes used by the native speakers, and a good monitoring process. Children who acquire a new language through acquisition do not consciously engage in monitoring process, unlike adults (S.D. Krashen, 1982). Moreover, Febriani et al. (2021) found that language acquisition in adults also occurred through the sensory experience, i.e., being exposed to listening to a new language, which stimulated students' cognitive thinking

processes. Thus, language acquisition in adults depends heavily on their environment, which in turns helps them to make language acquisition a more conscious process.

Can language acquisition occur faster for adults as opposed to children? Krashen and Mason (2020) argued that several factors influence successful acquisition in adults, affecting how quickly the process can occur. Krashen and Mason argued that language acquisition does not require a full understanding of every word that is heard; instead, the adult must be able to comprehend the input from their environment to recognize the word in its own context. This is often referred to as the social context of language learning, which is the environment where the second language is used, and its meaning is linked to its social constructs or circumstances. Moreover, it is critical for the learner to be in an optimal language environment, where all inputs are linguistically sound, to allow the learner the ability to place each word in a meaningful context. Indeed, Febriani (2020) found that the acquisition of a second language in adults was determined by the good input and processes from their environments. Ultimately, how fast the adult learner is able to acquire a second language depends on the quality of their environment and the work that is done to recognize and comprehend the meaning of words in their contexts.

Background, History, and Evolution of CALL

The history of technology and CALL programs are closely interlinked. CALL programs were initially introduced in the 1970s and were used mainly for drills and practice. As a result of limited integrative and communicative elements, scholars referred to the initial CALL programs as structural CALL, which was subsequently replaced by communicative CALL and integrative CALL programs in the later years (Kannan & Munday, 2018).

Between 1980-1990, communicative CALL programs were introduced, allowing users to carry out exercises (such as practicing dialogue with other students or carrying out commands given in a different language) within the programs to improve their communication skills (Kannan & Munday, 2018). This advancement significantly improved learners' level of achieved fluency and accuracy because they were able to practice their communication in authentic situations, unlike through the original technologies, which focused on repeating language from recordings. According to Makhmudov (2020), CALL programs allowed learners to develop their communicative competence, a core competence in language learning. This competence requires an element of social knowledge on when to use these elements, making it more complex for a program to teach this skill. A challenge that previous technologies were unable to address was learners' ability to develop the communicative competence in a second language due to the element of social knowledge required to fully understand when to apply the elements of morphology, syntax, and phonology effectively. Fortunately, CALL programs introduced in the 1980s were better able to address this challenge.

The most advanced version of CALL, integrative CALL, was introduced in the late 1990s. This advancement was supported by the growth of the internet in the late 1990s, which enabled more people to access and share information than ever before. Integrative CALL was characterized by allowing learners to access multimedia tools through the internet, enabling them to start their language learning in a classroom-like environment with access to the same materials that are available in print in a physical classroom. Also connected through the internet, integrative CALL programs imitated the authentic social context of language learning, meaning that learners were able to practice

their skills in a computer-assisted social setting (Kannan & Munday, 2018). Social interaction was considered a necessary aspect of language learning because it helped to integrate communication practice and language teaching (Reinhardt, 2018). Teachers soon began to implement these advancements into school language learning programs.

Ultimately, advancements in technology and CALL created significant opportunities in language learning that were not offered by earlier technologies. As mentioned previously, CALL programs allowed learners to support their language learning through tasks, creative language activities, and authentic social experiences that enabled them to optimize their language learning experience (Mula et al., 2017). These opportunities meant that students had improved levels of motivation, which is critical for success in language learning (Reinhardt, 2018). Previous methods focused primarily on attaining grammar, writing, and reading skills, as opposed to developing oral communicative competence, thus making second language learning more like first language (L1) acquisition. This stands in contrast to CALL, which successfully incorporates communicative competence into its learning process. Moreover, the creative aspects of CALL mean that students are able to collaboratively construct new knowledge of a second language and engage in online communities to support their autonomy in language learning (Mula et al., 2017). Thus, students become more motivated and engaged in their foreign language learning, which is a significant improvement from the more rigid and structured technologies from the 1960s and 1970s. Ultimately, advancements in technology and the rise of the internet meant that more individuals became attracted to the prospect of foreign language learning; as a result, more opportunities were created for them.

Second Language Teaching

As discussed previously, SLA and second language learning occur through different processes. The teaching processes for SLA have been theorized by several scholars, most notably with the work of Stephen Krashen in the 1980s. Krashen's work was built upon the works of scholars such as Michael Long, Merrill Swain, Richard Schmidt, and Bill Van Patten. In the following sections, first, the language teaching approaches developed by Stephen Krashen will be presented. Then, developments in second language teaching approaches since the work of Krashen will be described. S. Krashen (1981) delineated seven different approaches to second language teaching that captured the processes involved in SLA and second language learning: grammar-translation, audio-lingualism, cognitive-code, the direct method, the natural approach, total physical response, and suggestopedia.

Grammar-Translation. Grammar-translation, refers to the process of explaining a language's grammatical rules to the student (Krashen, 1981). A teacher can help the learner acquire the new language by providing examples of sentences using a particular grammatical rule. The teacher can also provide the student with a reading section explaining the grammatical rule, which simultaneously incorporates some vocabulary from the second language. Thus, during this teaching session, the learner acquires knowledge about the words used in the second language and how these words can be applied grammatically in a sentence. The learner then practices this knowledge through exercises.

Based on the practices involved in this teaching method, it becomes clear that this is an approach for a more mature learner rather than a child due to a heavy reliance on

learning and memorization. Moreover, there is little focus on natural language acquisition; instead, the learner is required to learn the right grammatical structure of a sentence and the necessary vocabulary (S. Krashen, 1981). Also, because these are typically taught in the learner's first language, there is little opportunity for natural language acquisition, which is common among young children.

Audio-Lingual Method. In this method, the teacher relies on an audio dialogue containing the necessary grammatical structures and vocabulary. The learner acquires knowledge about grammar and vocabulary through memorizing and repeating the dialogue to the teacher/fellow classmates (Krashen, 1981). This teaching method focuses heavily on simple repetition, translation, substitution (of different words in the same grammatical context), and transformation.

As with the previous teaching method, the audio-lingual method relies heavily on memorization and repetition. Despite this, the learner has more opportunities for oral language acquisition than with the grammar-translation method. In the audio-lingual method, the learner is exposed to audio dialogue using different vocabularies in the same grammatical context, which allows them to acquire new language knowledge (Krashen, 1981). However, this is still not the optimal language acquisition teaching method, according to Krashen (1981).

Cognitive-Code. The cognitive-code teaching technique, which was first formulated by J.B. Carroll and Kenneth Chastain in 1968, is the third approach to language teaching. The method focuses on developing four core language learning skills: reading, writing, listening, and speaking. In this method, the learner is exposed to various types of language input (written or audio), where they are required to practice speaking

the written text, listening to others speak, reading, and writing based on their learned knowledge (Krashen, 1981). This method replicates that of grammar-translation, where the learner is explicitly taught the principles of grammar rules and the necessary vocabulary. During cognitive-code teaching, there is a significant focus on developing the learner's communicative skills, where the learner is able to practice what they learned using writing, speaking, listening, and reading. As a result, there is naturally more language acquisition. However, Krashen (1981) argued that this method oversimplified teaching and learning, and thus was not an optimal method of teaching.

The Direct Method. The direct method, first formulated by Berlitz, entails the instructor's use of concrete instances of language, such as grammatical principles or vocabulary, while engaging with pupils. During this method, the teacher uses specific examples of language (such as specific grammar rules or vocabulary) when teaching their students. The students are then prompted to guess the language rules based on what the teacher says (S. Krashen, 1981). This method allows the students to learn grammar inductively, that is, through drawing their own conclusions. There is also more interaction between teachers and students than with other methods.

This method is a comprehensive approach where more input is provided by the teacher, as opposed to the more passive teaching methods discussed previously. The teachers focus heavily on speaking with the students using correct grammatical structures, creating a positive learning environment (S. Krashen, 1981). However, S. Krashen (1981) argued that this method focused too much on grammar, making it less than optimal for language learning.

The Natural Approach. The natural approach, a teaching method created by Stephen Krashen and Tracy Terrell, involves the instructor using only the second language and emphasizing language learning through understandable information. In this teaching method, the teacher only speaks in the second language, and the entire focus is on learning the language through acquisition and comprehensible input. Although the teacher only speaks the second language, students are allowed to ask questions in their first language (S. Krashen, 1981). When using this method, the teacher does not correct the students in their delivery; instead, students learn by recognizing their mistakes. This approach also encourages more active problem-solving from the students.

This teaching method is dedicated almost entirely to language acquisition, replicating the experience that young children have when acquiring a new language by simply being exposed to it. However, S. Krashen (1981) recognized one main weakness of this approach, arguing that the natural approach may not be as rewarding or stimulating for all students equally, given that some may be at different levels than others.

Total Physical Response. The total physical response (TPR) technique, initially introduced by James Asher, necessitates students' active compliance with instructions provided by the instructor in the target language. In this method, students are prompted to actively respond to what the teacher says in the second language. For instance, if the teacher tells the student to do something, they are expected to understand and respond to the command appropriately (S. Krashen, 1981). As students learn more commands, the teacher increases their complexity and difficulty. This approach builds from the natural approach, as students are expected to act as opposed to simply listen to a new language.

Additionally, the total physical response helps the learning process to be engaging and interesting for students and has the potential to produce better results than the other traditional teaching methods discussed earlier. However, S. Krashen (1981) argued that this approach can lead to speech delay for students, who are expected to simply react to a command instead of responding. Thus, this approach may not be as beneficial as a two-way dialogue could be.

Suggestopedia. The suggestopedia technique, established by Georgi Lozanov and described further by S. Krashen (1981), establishes a compact and concentrated classroom setting to provide pupils with a stress-free and soothing learning experience. In this method, the teachers create a small and intense class environment, ensuring that it is relaxing (achieved through meditation or music) and not stressful for the students (such as putting them on the spot to respond). The class occurs in the target language, where both teacher and students interact. The first language can be spoken occasionally, but the default transition is to the second language. The teacher is responsible for initiating dialogues on different and meaningful content, where real discussions can occur between students and the teacher. Krashen described this approach as the most optimal for language acquisition and learning, because it focused on the holistic approach instead of overemphasizing grammar. In the following section, the theory developed in the 1990s will be presented, beginning with the work of Michael Long.

Linguistic Aspects of CALL

CALL offers many interactive and collaborative opportunities for foreign language learners. CALL software can also support learners in the core language competencies needed for language fluency, which could have significant implications for

teachers, learners, and developers. This section focuses on exploring the role of CALL in developing the four core competencies as well as implications for relevant users.

Role of CALL

CALL offers a variety of tools that help the learner develop specific skills that ultimately contribute to the development of each of the four competencies. For instance, CALL learning allows learners to receive feedback on their written work, which can highlight areas of improvement in spelling and grammatical accuracy (Chen et al., 2021). Effective grammar is important in the development of writing and speaking competencies, whereas spelling is essential for the development of writing competency, and feedback can be a useful tool to help promote the development of competencies in foreign language learning (Li, 2018). Compared to paper-based feedback features, computed-mediated feedback is significantly more effective in improving learners' grammatical accuracy due to its greater accuracy and more interactive nature (Mohamed & Adnan, 2020). Similarly, CALL offers interactive web-based grammar instruction that not only promotes grammar learning but also facilitates collaborative learning with other learners (Li, 2018). A collaborative approach can help learners interact with others, thus allowing them to participate more in their community, which in turn improves the learner's listening and speaking competencies.

There is evidence to suggest that CALL can support students in producing more fluent and natural writing with limited errors (Lee, 2020). For instance, tools such as translations and corrections can help students learn to express themselves more effectively in writing because they can see how words and sentences are formed in a foreign language (Lee, 2020). Similarly, there is evidence to suggest that CALL can

support students in their paraphrasing skills, which involves comprehension of both reading and writing skills in a foreign language. By developing a more fluent writing style, learners can develop their metalinguistic awareness (that is, the learner's ability to reflect on the language in a way that allows them to recognize meaning and errors more effectively), which has several benefits across all competencies (Gelan et al., 2018). CALL learning also offers students access to web applications such as chat rooms, discussion boards, wikis, and databases. These tools help to promote learners' ability to co-construct text with other students, edit and revise the written text, and respond to feedback from others (Sharifi et al., 2018). These features help learners develop their reading and writing skills while promoting collaboration and interaction with other learners in the same language. Thus, these findings highlight that CALL effectively supports writing and reading competencies.

Listening in a foreign language can be a difficult skill for non-native speakers to develop. CALL programs allow learners access to multimedia tools, such as audio and video recordings, that learners can use to improve their listening comprehension in a foreign language (Zhang & Zou, 2020). Students' listening comprehension can improve when the learner is able to reach internal consistency, i.e., the ongoing interpretation of the spoken word and consistency in their predictions, which can be improved when the student is exposed to audio/video materials that can be revisited as much as required. Moreover, multimedia offerings help to increase learners' motivation through interaction with media. Although motivation does not directly contribute to competency development, it can help learners in the process (Nejati et al., 2018). Ultimately, CALL

programs help to facilitate interest in and convenience of learning, which can support the development of listening competency.

Another skill that CALL can promote is speaking. As established previously, CALL can help facilitate grammar learning through various tools. One of the tools is videos that expose the learner to real-life communicative situations, showing them how to apply their acquired knowledge in practical and everyday language contexts (Ghufron & Nurdianingsih, 2021). Videos can also support data-driven foreign language learning by observing the use of language within a context that highlights varying language features (e.g., the use of different verb tenses) as course content (Shadiev & Yang, 2020). This skill helps to promote listening and speaking competencies in foreign language learning, because the learner is able to comprehend the spoken language and its meaning, enabling them to speak in a foreign language more effectively.

Implications

There are several implications of using CALL for teachers and learners/users. This section will focus on exploring these implications in more detail. First, implications for teachers will be discussed before moving on to implications for learners and software developers.

Teachers/Instructors

Using CALL as a tool in the educational curriculum can benefit teachers based on their students' learning styles, characteristics, and specific educational conditions. Previous scholars identified that although the implementation of technology into teaching and language learning has been on the rise, few teachers actively incorporate it into their classrooms (Chen et al., 2021; Dehghanzadeh et al., 2019). There could be various

reasons for this phenomenon. For instance, some teachers may perceive CALL as too complicated to use or implement into their existing curricula, which can affect their willingness to incorporate it, primarily if they are used to the traditional methods of teaching (Bernacki et al., 2021). Moreover, factors such as personal attitudes toward technology, time management issues, resistance to change, poor technical and administrative support received from the school, and poor digital literacy are all factors that can make it more challenging to implement CALL into existing curricula (Dehghanzadeh et al., 2019). These are valid concerns because a lack of adequate digital literacy and technical support can impair the learning experience for students, cause confusion, reduce their morale, and impair their willingness to learn.

Implementing CALL into existing language curriculums also calls into question the teacher's role in the classroom. Some teachers may be more likely to reject this technology because implementing CALL can directly or indirectly affect their role in the classroom (Gonulal, 2019). Thus, CALL implementation may be associated with a role change in teachers who may not necessarily be ready or willing to change their roles (Hedayati et al., 2019). In traditional classrooms, teachers introduce students to the material, support their learning, and provide feedback (Zhang & Zou, 2020). However, because most of these functions can be done by CALL, the role of the teacher shifts more toward a supplementary and technical one. This concern goes against the teacher fit concept from Hubbard's (1988, 2006) model because the teachers may start to question whether they act as an instructor, trainer, practitioner, or developer in the classroom (Hubbard & Colpaert, 2019). These factors can have significant pedagogical considerations as the role of classrooms and teaching changes permanently.

Linguistic opportunities presented by CALL can have significant and positive implications for teachers and instructors of foreign languages. Scholars have identified that most foreign language teachers in Iran and Spain held positive beliefs about CALL and its contributions to foreign language education (Mei et al., 2018). CALL programs can support teachers in making the learning experience more interesting, engaging, and enjoyable for students. Assistive technology can allow teachers to become better facilitators because they can combine the language competencies (i.e., writing, reading, listening, and speaking) into one teaching session, as opposed to focusing on these factors separately, which has been done historically (Tafazoli et al., 2019a). Moreover, CALL tools can improve teachers' access to information and teaching materials, consequently improving their professional development and encouraging the use of different instructional approaches in their teaching (Mei et al., 2018). Similarly, many teachers believe that adding CALL into their foreign language speaking classes helps to improve their pedagogical approaches to students because the learning environment becomes more motivating, autonomous, and confidence-boosting for students (Tafazoli et al., 2019b). Thus, from these findings, it becomes clear that teachers recognize CALL's value to students' learning experiences. However, these findings do not indicate whether or not it makes teachers more likely to implement CALL in their classrooms.

In contrast, many teachers continue to believe that learning should be more teacher-centered than student-centered. This means that teachers want to take charge of the learning process instead of letting students take charge of their own learning (Shadiev et al., 2020). These attitudes can also be applied to teachers of foreign languages despite the research supporting a student-centered approach. Moreover, many teachers still hold

the perception that the quality of education depends on the quality of the teacher, as opposed to the use of assistive technologies such as CALL. This finding suggests that many teachers still do not recognize the contributions that CALL can make to their classrooms; instead, they appear to believe that their skills as teachers are more important to the overall learning process. Similarly, many teachers still believe that learning should be in the teacher's control, and that they play a dominant role in their students' foreign language progress (Alsuhaibani, 2019). Moreover, the same teachers that took part in the study by Alsuhaibani (2019) considered CALL to be a tool that helps to promote the better presentation of teaching materials and communication, as reported by Shadiev et al. (2020). Thus, it appears that teachers consider CALL a positive addition to the learning environment but consider it a beneficial teaching tool instead of a student tool that can help them take ownership of their learning.

Learners/Users

Learning a language is a skill that requires time, patience, and practice from the learners. CALL programs are designed to support students in acquiring core competencies, such as reading, writing, speaking, and listening. There is substantial evidence to suggest that CALL helps to achieve that goal. For instance, there is evidence to suggest that classrooms that have implemented CALL in their foreign language speaking programs experienced enhanced listening comprehension among their students (Tafazoli et al., 2019a). Additionally, CALL was shown to positively influence students' lexical (relating to words and vocabulary) and grammatical precision, fluency, and pronunciation. As an additional bonus, students have also experienced an improvement in their information and communications technology (ICT) skills as a result of using CALL

in their language learning (Mohamed & Adnan, 2020). Thus, some evidence suggests that implementing CALL can be beneficial for improving students' core competencies.

From a linguistic perspective, there is mixed evidence of the differences in effectiveness between CALL and in-class teaching methods. Buendgens-Kosten (2020) identified that classrooms that adopted CALL in their teaching methods did not significantly differ in their students' grammar achievements, when compared to traditional teaching-centered classrooms, suggesting that traditional, teaching-centered teaching methods can be equally as effective in language learning. Moreover, other researchers identified limited differences in the achievement of learning outcomes between students in traditional classrooms and those who used CALL (Buendgens-Kosten, 2020). Although CALL can support students in developing core competencies, such as writing and reading (Shadiev et al., 2020), there is limited evidence to suggest that it creates significantly different outcomes from traditional classroom learning (Enayati & Gilakjani, 2020). Thus, the implication for learners is to decide whether or not they have the resources available to them to choose to learn through CALL, especially because some students may experience additional challenges with using CALL related to having equipment and classroom resources like paper and pens, as well as the fact that using it may have no direct impact on their learning outcomes in the long run, making it potentially an undesirable mode of education.

In contrast, some negative implications may exist for learners using CALL programs. For instance, there may be some challenges associated with the additional workload for learners because they have to not only learn a new language but also adapt to the new system of learning (Gelan et al., 2018). Similarly, CALL programs promote

more autonomous learning, in which students engage in self-learning instead of in-class time. Although this has the added benefit of building self-confidence and motivation, this approach may not always work for every student (Turan & Akdag-Cimen, 2020). Moreover, CALL programs may require students to prepare independently for their in-class study time (Gelan et al., 2018). In classrooms, students can receive additional support from their teachers, who can help them overcome learning challenges and direct them as needed (Turan & Akdag-Cimen, 2020). Such help is unavailable when students engage in self-learning, which can pose a significant challenge for some students.

Software Developers

With respect to the linguistic learning opportunities (focused heavily on the four core language competencies in language learning) provided by CALL, software developers are responsible for ensuring that a program offers the right tools to support students in their learning. As stated previously, CALL programs focus more on a student-centered approach to learning than a teacher-centered approach, meaning learners have the ultimate responsibility for their own learning. This can make developing certain skills, such as speaking in a foreign language, more challenging because the learners need a space to have an interactive and mutual interaction where they practice listening and speaking in a new language. This means that software developers need to design the interface of CALL to interactively promote self-learning, mimicking that of a traditional classroom (Tafazoli et al., 2019b). This would then help students to develop their linguistic learning more holistically.

The most beneficial design of CALL software is a tutorial. This format allows students to learn through computer-assisted feedback and online exercises (Prastikawati,

2019). The more interactive the exercises, the better the program is at replicating the learning experience of a traditional classroom, which can support competence development, such as speaking. Moreover, these formats also provide additional learning materials, which can take the form of audio, video, or text. These formats can support listening development, as the learners require access to verbal and audio stimuli and social cues to process and apply learned knowledge. These formats also help to support listening competency when learning a new language. Other CALL software is designed using task-based activities, encouraging and rewarding students for completing various learning-related tasks (Prastikawati, 2019). Thus, software developers are responsible for ensuring that the software interface is designed to promote the most effective learning methods and is easy for learners to use.

Technological Aspects of CALL

Previous sections have explored some of the linguistic implications of CALL. From the analysis, it is apparent that several technological aspects of CALL may have some implications for teachers, learners, and software developers. This section will explore these implications in more detail.

There are several implications of using CALL on its end-users and its developers. This section will focus on exploring these implications in more detail. First, implications for teachers will be discussed before moving on to learners and software developers.

Teachers/Instructors

To successfully implement CALL programs into their language learning curricula, teachers must have access to appropriate technological facilities. Unfortunately, many language classes lack technological tools supporting CALL programs, such as up-to-date

computer systems and a stable internet connection. There is an added challenge of maintaining these technologies; even though this job is not strictly a duty of the teachers, it plays a big role in their classroom teaching. Teachers need to have adequate knowledge about using such equipment appropriately; otherwise, the equipment may become run-down or unusable. Some teachers may also lack the necessary training and understanding of how to use and adapt this technology for their own teaching (Tafazoli et al., 2019b). These limitations may also affect the mindset of the teachers, who could be less willing to adopt these technologies and focus on what they are good at: traditional teaching methods. Some scholars have also recognized that certain software suitable for CALL courses is not readily available in schools, and teachers may have difficulty accessing appropriate programs (Nariyati & Pratiwi, 2020).

There are also various usability implications that can affect teachers' willingness to implement CALL in their classrooms. For instance, a lack of stable internet connection may discourage teachers from using CALL in their language teaching classes. Although this is more of a school connectivity issue than a problem with CALL's usability, it can directly affect teachers' level of motivation and engagement in implementing CALL into classrooms (Bontogon et al., 2018). Moreover, many public schools have poorer access to computers, hardware, software, and infrastructure, all of which are necessary to support using CALL in classrooms. A lack of appropriate infrastructure may affect the level of verbal/visual stimuli received by students, which can negatively affect their ability to receive, interpret, process, and respond to these as part of competence learning. Thus, the inconvenience encountered by teachers due to the lack of availability of the right technology may deter them from using CALL and affect students negatively (Nariyati &

Pratiwi, 2020). Moreover, a school's lack of willingness to invest in more advanced technology to support CALL may also indirectly affect teachers' willingness to implement it into their programs (Bontogon et al., 2018). Thus, factors such as infrastructure and challenges with understanding this technology can significantly affect teachers' attitudes and positive beliefs about technology and CALL, which will affect their likelihood of implementing these tools.

Learners/Users

An additional implication for learners and users is a lack of familiarity and knowledge about CALL programs and a lack of relevant training. Many learners lack adequate knowledge about how to use the CALL infrastructure, which can affect their ability to use it to support their learning. For instance, learners may become too preoccupied with trying to understand the CALL system and be less able to effectively reflect and engage with the learning material. At the same time, many schools lack training on technological innovations because, for many schools, this is not considered a priority in terms of learning outcomes. Scholars have found a significant positive correlation between training and positive attitudes of teachers and learners with respect to using new technology, highlighting the importance of implementing appropriate training to increase learners' willingness to adopt technology (Tafazoli et al., 2019a).

Further evidence suggests that many teachers and learners in schools lack sufficient knowledge of CALL despite attending relevant training. Thus, learners who are not aware of the potential benefits of CALL and are not properly trained to use it may not use it to its full potential and may become discouraged by technical challenges. In this situation, the learners may feel discouraged from engaging with the written or verbal

stimuli effectively, which can affect their ability to develop their language learning competence (Tafazoli et al., 2019b). Thus, implementing CALL into their learning will pose a significant challenge for learners who may lack adequate skills, access to relevant training, and proper knowledge to utilize this software to the best of their ability.

Software Developers

Some aspects of CALL are web-based, but still have implications for software developers due to various applications that operate together with the website. Internet-based applications are hosted on server computers to create role-playing games that users can access from their home computers as a digital ecosystem that promotes language learning (Mei et al., 2018). Role-playing games allow learners to participate in activities where they can work collectively with other learners or compete against each other. As part of the activities on web-based platforms, learners have to interact with landscapes, objects, and text on their screens as part of their learning (Mei et al., 2018). Based on the quality of those interactions, the student is able to collaborate effectively with other learners and improve their learning as a result. Interactions are specifically important when developing listening and speaking competencies, as the learner uses that interaction to convey new information, process it, and respond to it appropriately based on language knowledge and social cues. Thus, software developers are responsible for designing a platform that mimics real-world communicative situations to allow students to engage in their learning. Moreover, some platforms are designed as video game experiences, requiring multi-user capability (Tafazoli et al., 2019b). As a result, software developers are challenged to design the visual and textual elements of such environments to create learning environments that replicate the in-classroom experience.

Educational Aspects of CALL

Two key models were proposed to evaluate and conceptualize CALL in education. Philip Hubbard conducted the initial work, followed by Carol Chapelle, who further developed the work that Hubbard undertook. This section thoroughly explores both frameworks before discussing the potential implications for teachers, learners, and software developers.

Two Major Models: Hubbard and Chapelle

Hubbard

Philip Hubbard (1988) was one of the key theorists to evaluate CALL software and its implications for education. Hubbard (1988) decided to build on previous methodological frameworks for CALL software evaluation. He argued that until the mid-1980s, the methodological evaluation of CALL was conceptualized using procedures and checklists typically applied in the education system as a whole instead of a singular focus on language learning. Hubbard (1988) decided to build on the framework adopted by Martin Phillips in 1985, which focused more on the language teaching methodology and addressed language difficulty, language focus, and learner focus as part of the language learning process. Consequently, Hubbard developed an approach that described and analyzed language teaching methods built on an approach initially introduced by Richards and Rodgers (1982).

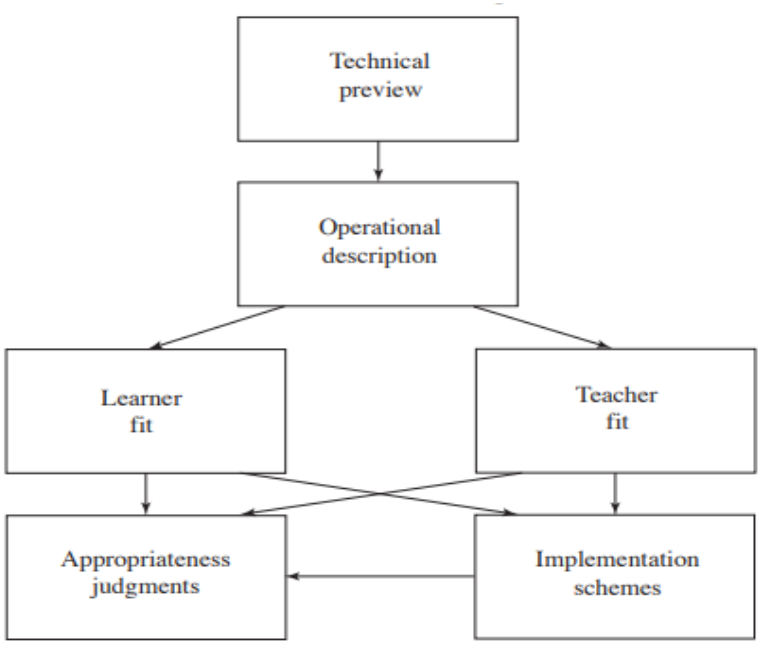
In his framework for classifying language teaching methods in relation to the approach, design, and procedure, Hubbard's (1988) approach referred to the language learning assumed by the method. In Hubbard's framework, the "design" referred to key components of teaching methodology. This included the syllabus model used, the stated

objectives of the chosen teaching approach, and the roles assigned to teachers, students and learning materials in supporting the overall language learning process. Lastly, the procedure referred to the techniques or activities that helped with the realization of the design. However, Hubbard (1988) decided to build on these steps and rename them as teacher fit, learner fit, and operational description.

Hubbard (2006) redeveloped his framework in 2006, introducing a software evaluation framework under which he assumed that the language learning software being evaluated according to his framework had already undergone a pre-evaluation where its suitability was predetermined. Based on this assertion, the updated framework adopted by Hubbard consisted of the following stages (see Figure 1):

Figure 1

Software Evaluation Framework: Core Components



Note. Adapted from "Evaluating CALL software" by P. Hubbard, 2006, in *Calling on CALL: From Theory and Research to New Directions in Foreign Language Teaching* (pp. 313-338). CALICO. Copyright 2006 by the author.

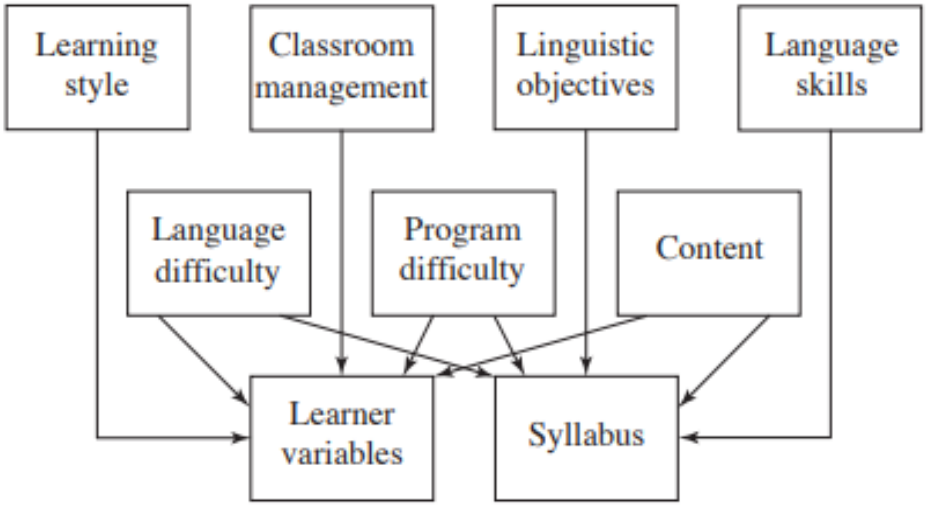
1. Technical preview: The instructor should ensure that the chosen software can run successfully on the selected equipment the learners will use.
2. Operational description: The instructor should review the main functionalities of the software to understand the flow of lessons and items and how the user will experience the software. This will also help the instructor understand how the system operates, allowing them to support students' learning.
3. Teacher fit: This is one of the initial steps proposed in Hubbard's (1988) framework. This step involves understanding what language teaching approach the software reflects to determine its compatibility with the teacher's way of teaching.
4. Learner fit: This was another step from Hubbard's (1988) original framework. Figure 2 presents the elements involved in determining a learner fit. In this process, the instructor should determine how well the software's content and language level were taught and how these fit with the learner's skills and abilities. Moreover, in this stage, the instructor should determine how well the software matches the student's preferred learning style and language interests. At the same time, the program difficulty and linguistic objectives should be considered, as well as the difficulty of the language being taught. The teacher should also determine how their chosen teaching methods relate back to the syllabus taught, classroom management, and learner variables.
5. Implementation schemes: This step refers to how the instructor can adopt and integrate the language-learning software into the layout of the existing curriculum. More specifically, this stage focuses on how the software can be

integrated into students' existing knowledge to support and not complicate their learning.

6. Appropriateness judgments: The final step of the updated framework focuses on the instructor's judgment in implementing the software into their classroom. After the instructor goes through all of the earlier steps, they can decide whether to use it or not, based on how well the software works with the instructor, learner, and the existing curriculum. All of these steps are shown previously in Figure 1.

Figure 2

Elements of Learner Fit



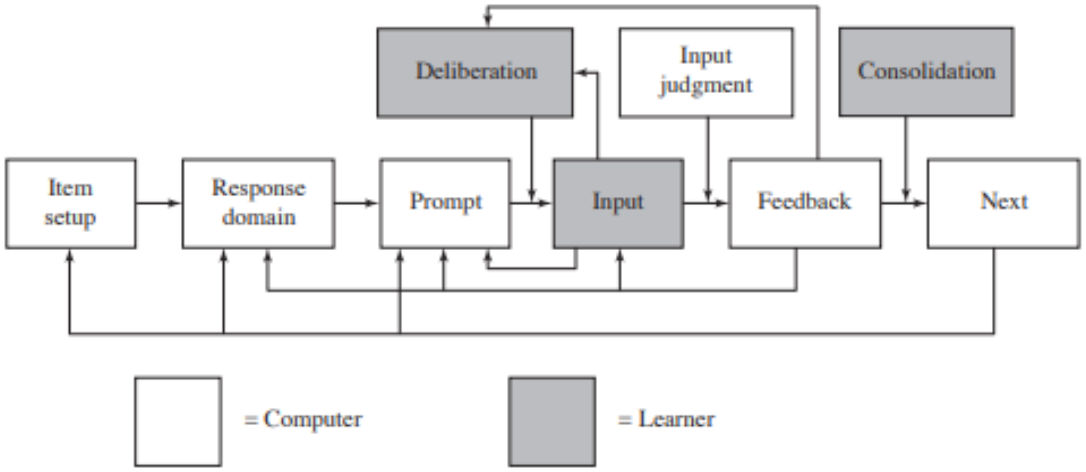
Note. Adapted from "Evaluating CALL software" by P. Hubbard, 2006, in *Calling on CALL: From Theory and Research to New Directions in Foreign Language Teaching* (pp. 313-338). CALICO. Copyright 2006 by the author.

Although Hubbard (2006) did not integrate operational descriptions into the model mentioned previously, he dedicated a separate model to reviewing the components of the software to determine how well the software can be used and controlled by the user: in this case, the learner. Instructors can review the software's components to

support their decision regarding whether to implement it into their teaching. In his original framework, Hubbard (1988) focused on presenting independent central and peripheral components of the software; however, in the updated model, Hubbard (2006) described how these components connect (see Figure 3).

Figure 3

Interactional Sequence Model for Interrogation Mode



Note. Adapted from "Evaluating CALL software" by P. Hubbard, 2006, in *Calling on CALL: From Theory and Research to New Directions in Foreign Language Teaching* (pp. 313-338). CALICO. Copyright 2006 by the author.

1. The first component of software description is its screen layout and interface. This step focuses on the software's basic appearance, including its controls, color schemes, fonts, graphics quality, audio, video, presence, and placement. This is an essential part of any software because it ultimately dictates how well the instructor and learner can use it. Thus, the initial step focuses on the aesthetic and cognitive aspects of the software.
2. The second component is the timing of the software. This component refers to the amount of time the content and materials appear on the screen, limiting the

time the student has to respond. Another feature of CALL software includes recording the time it takes students to perform their activities.

3. The third component refers to the control options of the software. This step describes the factors under the learner's control and those under the program's control. This step also focuses on the physical nature of the controls, such as the learner's ability to go through the content, use a menu, and choose a lesson, and whether or not the software requires the learner to complete one lesson before being allowed to progress to the next. Moreover, Hubbard (2006) emphasized the importance of the learner's ability to call up text support when completing video or audio exercises. He also argued that more advanced language learners prefer using more flexible software with more control. In contrast, novice learners and beginners tend to choose more structured software with less freedom and control.
4. The fourth component involves user input. This component refers to how the learner responds to the implicit and explicit prompts from the software. The user input could consist of typing, clicking a button, or speaking. This component was not discussed in Hubbard's (1988) original framework.
5. The fifth component refers to the program's procedure for managing the user's input. The program's procedure could consist of responding to users' actions such as clicking, linguistic parsing, pattern matching, or speech analysis.
6. The sixth component refers to the learner's feedback from the program. Feedback issued by the program to the user can either be implicit (which

includes a simple message when an incorrect answer is given) or explicit (which is less vague and provides more detailed feedback to the learner based on their activity). This is an integral part of the software because it determines whether the software has a more active teaching presence than others. Software with a more active presence can provide feedback with more information, such as further explanations or instructions. Other active feedback can consist of a simulated dialogue, where the program responds orally to the learner's input or performs a requested action. Software with a more passive presence can indicate whether the learner's input is correct or incorrect or provide limited additional information such as hints. Moreover, feedback can also include the learner's scores and performance data, which they can subsequently review.

7. The final component of operational review refers to the software's help options. This component relates to the description of the content of the help, in addition to how well help is personalized at every stage. For instance, this refers to whether help is targeted for every item or content within the program or whether help is generalized to all components. Moreover, this stage also refers to reviewing whether help is always available to learners or only during specific conditions. The model presented earlier summarizes all the steps discussed previously (see Figure 3).

Chapelle

Carol Chapelle was another prominent theorist regarding CALL software. In her model, Chapelle (2001) combined the aspects of CALL and computer-based language

testing and computer-based SLA research to conceptualize CASLA. In her model, Chapelle focuses on characterizing and evaluating CASLA and presenting its specific SLA-based criteria. She offers the following five principles that are used for assessing the suitability of CALL.

1. CALL evaluation should be situation and scenario-specific because not all CALL applications in language learning are the same.
2. The evaluation criteria of CALL should be based on SLA theory and related research.
3. CALL evaluation should be examined from two perspectives: (a) a judgmental analysis of CALL software and activities and (b) an empirical analysis of the learner's performance.
4. The criteria on which a CALL evaluation is based should be applied to the relative purpose of the task.
5. Lastly, when evaluating CALL, special consideration should be placed on its language learning potential.

Chapelle proposed that assessments of CALL should be approached from two perspectives: (a) a critical assessment of CALL software and activities and (b) an evidence-based study of the learner's performance. Table 1 displays the evaluation methodologies suggested by Chapelle.

Table 1

Evaluands, Questions, and Evaluation Types Proposed by Chapelle (2001)

Level of analysis	Object of evaluation	Example question	Method of evaluation
1	CALL software	Does the software provide learners the opportunity for interactional modifications to negotiate meaning?	Judgmental
2	Teacher-planned CALL activities	Does the CALL activity designed by the teacher provide learners the opportunity to modify interaction for negotiation of meaning?	Judgmental
3	Learner's performance during CALL activities	Do learners actually interact and negotiate meaning while they are working in a chat room?	Empirical

Note. Adapted from "An Evaluation Framework for CALL" by B. L. McMurry, D. D. Williams, P. J. Rich, and K. J. Hartshorn, 2016, *The Electronic Journal for English As a Second Language*, *20*(2), 1-12. Copyright 2016 by the authors.

In addition to these five principles for evaluating the suitability of CALL, Chapelle (2001) also proposed six general evaluation criteria that can help determine the appropriateness of any CALL task in supporting learners in their language learning and acquisition process. Chapelle argued that these criteria should be applied to all CALL tasks defined by the software and the instructor. These criteria are as follows:

1. Language learning potential: This criterion refers to the degree of the opportunity presented by the task, which will support the learner in developing greater focus and skills.
2. Learner fit: This criterion refers to the amount of opportunity the task presents for language engagement, which depends largely on the learner's characteristics and preferred learning styles.

3. Meaning focus: The third criterion focuses on the extent to which the learners remain attentive and focused on understanding the meaning of the language and how well the task can facilitate those abilities.
4. Authenticity: This criterion refers to the degree of correspondence between the learner's activity and the language-related activities outside the classroom that interest the learners.
5. Positive impact: The fifth criterion refers to the overall positive effect of CALL on its learners and teachers.
6. Practicality: The last criterion refers to how resources support language learning activity within CALL.

Chapelle's (2001) CALL framework is structurally quite different from Hubbard's (1988, 2006) in that it generally holds different assumptions about language learning and CALL. However, in some respects, both methodological frameworks are compatible. For instance, the concept of learner fit described in Chapelle's six general evaluation criteria can be linked back to Hubbard's model. In contrast, the remainder of Chapelle's criteria are more task-based than the principles presented by Hubbard, who focused more on the teacher fit approach alongside learner fit. Table 2 illustrates the SLA-based approach proposed by Chapelle (as cited by Jamieson et al., 2005). This approach focuses on determining the language learning potential specifically, and specific criteria that need to be met to ensure that the task offers the opportunity to support the learner in their language learning.

Table 2

CALL Criteria and Operationalization

Criteria	Operationalizations	Desired responses to support claims for quality
Language learning potential • Sufficient opportunity for beneficial focus on form	• Will the grammar, vocabulary, and pronunciation that was studied during the week be remembered?	• Yes
	• Were the explanations clear?	• Yes
	• Were there enough exercises?	• Yes
	• Will the students' English improve as a result of *LEO 3*?	• Yes
	• Will the students' quiz scores indicate mastery of the material?	• Yes

Note. Adapted from "CALL Evaluation by Developers, a Teacher, and Students," by J. Jamieson, C. Chapelle, and S. Preiss, 2005, *CALICO Journal, 23*(1), 93-138. Copyright 2005 by the authors.

The above section aims to identify the current research trends on the evaluation of CALL effectiveness on language learning that will be relevant to future software developers. Moreover, this section will highlight current methodological trends and approaches utilized less often. This discussion will help to identify factors that are under-researched concerning CALL.

Evaluation of CALL Effectiveness

Many of the previously conducted studies on CALL concentrated on teachers' intentions, perceptions, and attitudes instead of discussing the software's fit for the teacher, which is what the current study sought to explore. For instance, a study by Alsuhaibani (2019) focused on how teachers' beliefs were defined, along with a presentation of the importance they place on their beliefs and how they are formed. Alsuhaibani also discussed teachers' beliefs about CALL implementation in language classrooms and the factors that affect them, followed by a discussion of whether teachers' beliefs about technology reflect their actual practice. Similarly, Cheong et al. (2018)

compared ubiquitous outdoor learning with classroom-based computer-assisted learning; theirs was the first study of its kind to compare the two in the context of language learning. However, Cheong et al. did not focus on how well CALL could support teachers in their teaching; instead, this study focused solely on comparing the two methods.

Similar trends were observed in CALL-focused studies that examined students' perceptions and outcomes without providing a practical review of how well the software fits learners' needs. Lee (2020) argued that computer-assisted translation could be used in classrooms to decrease student translation errors and highlighted areas for improvement. However, Lee did not suggest ways in which software can be improved to support students in making fewer mistakes in the first place. Likewise, Li (2018) discussed pedagogical recommendations regarding writing tasks, grouping, student training, and assessment, but did not consider ways CALL programs can be improved to support pedagogical approaches.

Furthermore, some studies were identified that addressed elements of learner fit and teacher fit to some extent. For instance, Bahari (2021) highlighted reports that have been overlooked for decades, showing the inconsistency and deficiency of adopting pencil-and-paper duplicates for computer-assisted assessment purposes. This is an interesting investigation of how CALL can be redesigned for learners who may not have access to the necessary equipment and internet connection to use the software, thus increasing the software's suitability. Similarly, Bahari and Gholami (2022) argued that teachers should take advantage of CALL strategies to reduce some of their workloads. Still, they should also test the strategies before implementing them across the board to

ensure their effectiveness. These studies present some suggestions for CALL improvements to its suitability for students and teachers alike, but more research is required on this topic.

Some studies were conducted specifically on CALL itself. One such study was conducted by Đorđević (2020), who looked at the impact of CALL on the understanding of meanings of modal verbs (words that express a necessity or possibility, often used to supplement a sentence) in legal English (MMVLE) and levels of motivation in English for specific purposes (ESP) course. In an experiment, the researchers divided students into two groups. One group had face-to-face classroom instruction, whereas another group had face-to-face and CALL instruction. The researchers found that those students who engaged in CALL instruction experienced higher motivation levels.

In their study, Bahari (2021) reviewed 286 peer-reviewed articles from 2002-2018 to identify the mainstream assessment tools and strategies adopted for language proficiency assessment in CALL studies. Moreover, Bahari and Gholami (2022) looked to report on challenges highlighted in the existing research surrounding computer-assisted technologies used for language learning. They identified a need to collect the data from software developers to determine the best fit for teachers. Thus, there is much focus on reviewing CALL's tools and task-based functionalities within language learning.

Moreover, Ghufron and Nurdianingsih (2021) studied how CALL and the flipped classroom method (that is, the requirement for students to possess a certain level of knowledge before entering the classroom and using classroom time for practice) affected English as a foreign language (EFL) writing outcomes. The researchers did find a statistically significant difference in students' EFL writing performance before and after

the flipped classroom intervention, meaning it is moderately effective. Lastly, Mei et al. (2018) measured teachers' intentions to adopt CALL strategies. They found that teachers were more willing to adopt CALL if they felt the conditions were right for them, that is, if they had the necessary knowledge, skills, and resources. Additionally, other studies did not focus on CALL specifically and its impact on the effectiveness of language learning. For instance, Li (2018) reviewed 21 representative articles on computer-mediated collaborative writing published from 2008-2017. Similarly, Parmaxi (2023) conducted a standardized literature review examining work focused on VR used in language learning. These studies also focused on the functionalities of the software, with little emphasis on learner fit and teacher fit.

Thus, there is evidence of scholars conducting some experiments to determine teacher intentions and learner outcomes related to CALL. However, there remains a shortage of studies to determine the learner fit and teacher fit of CALL from the perspective of software developers who are responsible for designing the programs in the first place. Rather than assessing the effects of existing CALL programs on learner and teacher outcomes, this study adopted a different approach to understand how software developers believe the programs can be improved to support learners and teachers.

Summary

This literature review presented a historical overview of CALL and the trends in learning a foreign language due to the shift toward individual learners acquiring 21st century learning skills to improve their language competencies: reading, writing, listening, and speaking. Additionally, key CALL-related concepts were discussed concerning CALL software development and its implications for educators, users, and

software developers. This review also revealed that current studies on CALL have focused more on teachers' intentions, perceptions, and attitudes instead of discussing the software's fit for the teacher. Moreover, there remains a shortage of studies to determine CALL's learner and teacher fit. This gap formed the basis for the current study, which sought to determine how software developers can design CALL programs that achieve both learner and teacher fit in ways that help promote core competency (reading, writing, listening, and speaking) development.

CHAPTER III: METHODOLOGY

Overview

Chapter I provided an introduction to the study and background to the research. The chapter included the research questions, the research problem, the significance of the study, as well as definitions, delimitations, and the organization of the study. Chapter II presented a review of the literature on CALL software and the role of software engineers in developing CALL programs in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher fit and learner fit. Additionally, the chapter included a description of the gap to be addressed in this study.

This chapter presents the methodology applied to explore the experiences of CALL software developers in the context of four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. Chapter III reviews the purpose statement and research questions, research design, population, sample, instrumentation, data collection, and data analysis. Additionally, the chapter describes the rationale behind the research and the research steps to establish the reliability and validity of the data collected. Following the guidance of Flick (2018), the validity of the qualitative data in this study was maintained by considering the data recordings and interview transcripts as objective depictions of the phenomenon from which an interpretation through data analysis was developed.

Purpose Statement

The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL

software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit.

Research Questions

The following research questions guided this study:

1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking?
2. How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?
3. How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?

Research Design

The focus of the study was the pedagogical meanings attached by CALL developers to the software solutions they designed as well as the current state of foreign language acquisition at the time the research was conducted. Additionally, with the alignment of the research questions, the study focused on CALL developers' descriptions of their experiences when designing their software for the four language competencies (reading, writing, listening, speaking), along with teacher fit and learner fit. Therefore, a qualitative methodology was selected for this study because it sought to explore and describe a phenomenon rather than investigate the numeric relationship between variables (Creswell & Creswell, 2018). Qualitative descriptive studies allow the researcher to use a naturalistic approach and do not require adherence to any one theory or conceptualization. Instead, the description of the phenomenon developed in qualitative

descriptive research should focus on presenting and describing the phenomenon in-depth (Sandelowski, 2010).

This method aligned well with the purpose of the study because it involves real-world issues and settings (Roberts & Hyatt, 2020). Having analyzed all the appropriate qualitative research designs, it was determined that the study should be descriptive in design. The choice of this design lies in the fact that descriptive qualitative studies are used "to describe a phenomenon and its characteristics" (Nassaji, 2015, p. 129). Moreover, qualitative descriptive research designs are appropriate when there is a limited understanding or description of a phenomenon (Sandelowski, 2000).

Population

According to McMillan and Schumacher (2010), a research population is "a total group to which results can be generalized" (p. 143). The population of the study comprised the Computer-Assisted Language Learning Consortium's (CALICO) active members. CALICO is an international organization dedicated to research and development in the use of CALL. The total number of CALICO members on March 24, 2022, was 1,732.

Target Population

The target population differs from the list of individuals from which the sample is selected (McMillan & Schumacher, 2010). Upon receipt of institutional review board (IRB) approval, the researcher reached out by email to the CALICO staff to send out a recruitment flyer (Appendix F) to all active CALICO members to identify the target population for this study. The target population for this study focused on CALL software developers who met the following three criteria:

1. Proven experience: Participants in the study were expected to have at least 3 years of CALL software development experience at the time of research.
2. Active CALL software development practice: Participants in the study were expected to be actively developing CALL software at the time of research.
3. Client recognition: Participants' software had to be recognized by CALL software practitioners (language educators, language lab directors, etc.). This recognition was determined by the number of positive reviews and higher ratings on the Apple Store and Google Market.

Sixty-two CALICO members who were CALL software developers reached out to the researcher and expressed their interest in participating in the study; these members made up the target population of this study. Most CALICO members are language educators, SLA researchers, CALL practitioners, and other professionals interested in exploring the use of technology for language teaching and learning.

Sample

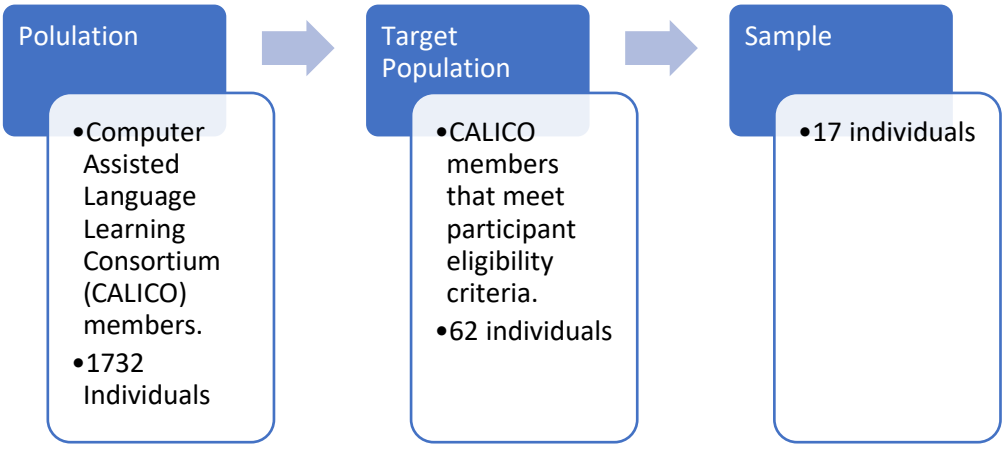
A sample is a group of people that are taken from a larger population that the researcher intends to study; the members of the sample serve as representatives of the whole population (Creswell & Creswell, 2018; McMillan & Schumacher, 2010). To narrow the target population into a sample population, the researcher sent out a follow-up email to all CALICO members who met the target population criteria, as described previously. In the email, the researcher provided more details about the research and inquired about additional information (such as demographics, educational backgrounds, possible experience related to teaching a foreign language, etc.) from the respondents. The final sample size used for the study comprised 17 active CALL software developers.

Sampling Procedures

Purposeful sampling procedure was considered to determine the sample for this study. The researcher chose participants according to the needs of the study by predetermining the criteria for study participation (Patton, 2015). When all email responses were received, the researcher analyzed them. Then, the researcher identified those respondents whose experience developing CALL software was the richest and those who were most widely recognized by CALL software practitioners (language educators, language lab directors, etc.). Seventeen active CALL software developers who were widely recognized around the world made up the sample of the study and were invited to participate in the interviews conducted in May-June 2023. Figure 4 schematizes the population, target population, and sample for this study.

Figure 4

Study Population and Sample



Note. The population, target population, and sample for the study.

Instrumentation

The research design used for this study was qualitative, so the researcher was considered the primary instrument in collecting and interpreting qualitative data. Although qualitative research methods are often criticized as biased because the researcher is the primary instrument of the study, McMillan and Schumacher (2014) argued that qualitative research is "a type of research that refers to an in-depth study using face-to-face or observation techniques to collect data from people in their natural setting" (p. 5). Qualitative research methods are designed in a manner that helps reveal the behavior and perception of a target audience with respect to a particular topic. The researcher designed appropriate interview questions based on the review of literature and the theoretical framework used in this study to provide a consistent data analysis and answer the research questions as precisely as possible. Researcher as an Instrument of the Study

According to Pezalla et al. (2012), "because the researcher is the instrument in semi-structured or unstructured qualitative interviews, unique researcher characteristics have the potential to influence the collection of empirical materials" (p. 165). This means that due to the role of the researcher as an instrument in this study, the study may have been subject to potential biases related to the researcher's personal and professional experience.

Being a foreign language educator involved in various curriculum design and development projects and a language instructor who practices using CALL software in his classroom, the researcher was mindful of how his personal beliefs could influence his interpretations. Specifically, he recognized that his pedagogical beliefs could bias his

interpretations of the data. To ensure that his assumptions were not influencing any research outcomes, the researcher was guided by the data, which was used to develop the findings in the data analysis process to reach thematic saturation (Bowen, 2008; Flick, 2018; Guest et al., 2006). Moreover, the researcher maintained a reflection journal to document personal beliefs and interpretations separately from the data analysis process.

Interview Questions

Prior to the data collection process, the researcher and the expert panel described later in this chapter devised a series of semi-structured interview questions (see Appendix A). The questions were proposed, and feedback was received from the expert panel whose members were knowledgeable of CALL software development and work in the field of SLA. Interview questions were designed to be linked to the research questions used to guide this study. Additionally, the interview questions were informed by the theoretical underpinnings of the study: CALL evaluation models developed by Hubbard and Chapelle.

Validity

Validity is often defined as the extent to which an instrument measures what it asserts to measure (Blumberg et al., 2014). Validity describes the degree to which the researcher measures what he or she intends to measure. Moreover, in qualitative research, ensuring validity involves assuring that the interpretation of the data appropriately represents the phenomenon under investigation (Flick, 2018). Because the researcher was the primary instrument of the study, the validity of this inquiry method depended extensively on his competency and the mitigation of bias. Additionally, to minimize bias

and ensure validity and reliability in the study and address any limitations of the study, the researcher undertook the following steps:

Pilot Interviews

A pilot interview was conducted prior to the actual data collection. The participant in the pilot interview was not part of the study's sample. The interview was video recorded and observed by the expert researcher. The expert researcher was selected based on the following credentials:

1. Earned a doctorate degree.
2. Has conducted qualitative research.

Once the expert researcher reviewed the mock interview video, the expert shared feedback related to delivery, pacing, non-verbal communication cues, volume, clarity, expression, engagement with the interviewee, and other interview techniques in order to validate the researcher's qualitative interview skills. Additionally, feedback was obtained from the pilot interview participant.

Interview Protocol

The interview protocol was first developed by the researcher and then refined by an expert panel that consisted of an active CALL researcher and two foreign language educators with doctorate degrees in linguistics. This process ensured that the instruments, particularly the interview questions, were posed in a way that contributed to answering the study's research questions. In other words, the experts selected to participate on the expert panel served to validate the structure, context, and alignment of the interview questions. The expert panel is described later in this chapter. The interview protocol can be found in Appendix A.

Member Checking

The researcher checked the accuracy of transcriptions completed by the Otter.ai online platform to ensure that the data recorded and transcribed from participant interviews accurately reflected participants' perceptions. As suggested by Patten (2016), "checking the accuracy of a transcription helps to ensure the quality of the data" (p. 157). Therefore, early in the data analysis phase, a member checking technique was implemented. All the study participants were asked to compare the audio recording of the interview with the transcription. All the transcriptions checked during the member checking process were found to be satisfactory.

Expert Panel as Instrument

The researcher sought out three experts in the field of CALL or foreign language acquisition to provide feedback on interview questions for potential participants. Experts selected to participate in the expert panel validated the structure, content, and alignment of the interview questions. The experts on the panel satisfied three of the following five criteria:

- Published author.
- Doctorate degree related to foreign language acquisition.
- Acknowledged CALL researcher.
- Experienced with the research topic.
- Two or more years of foreign language teaching experience at a college level.

Having collaborated with the expert panel, the researcher obtained substantial feedback on the research questions of the study and, as a result, established their validation.

Reliability

Reliability relates to the consistency of a measure (Hayashi et al., 2019; Lincoln & Guba, 1985; Nassaji, 2020). In other words, reliability is the extent to which an assessment tool produces stable and consistent results. Roberts and Hyatt (2020) also described reliability as "the degree to which the instrument consistently measures something" (p. 236). In qualitative research, because instruments and data are subjective and context-bound, reliability differs from the internal and external validity used in quantitative research (Flick, 2018; Hayashi et al., 2019). In the context of this study, three reliability protocols were utilized as appropriate for qualitative research (Yin, 2014).

Internal Reliability of Data

Consistency in the data collection, data analysis, and interpretation was critical to internal reliability in this study. Internal reliability is a way to ensure that another researcher would come to the same conclusions upon review of the same data. Additionally, to increase the richness and comprehensiveness of gathered data as well as to ensure the internal reliability of data, the researcher conducted a total of 17 interviews to see if patterns of experience had higher frequency counts.

External Reliability of Data

External reliability measured whether another researcher would get the same results or conclusions by reproducing the study. For this study, the results were not generalizable; hence, external reliability of the data was not a concern. Moreover, this issue of generalization was not as significant for qualitative research such as this study because of the difficulty recreating unique situations, human behavior, and interactions (LeCompte & Goetz, 1982).

Inter-Coder Reliability

Confirmability refers to the ability of the research interpretations to be confirmed by other researchers. In qualitative research, the reliability of the data can be enhanced by recruiting an additional person to analyze the data independently. By using an additional individual for data analysis, the reliability of the analysis is enhanced by ensuring the codes and themes developed from the respective codes are not subjective, representing only a single researcher's interpretations (O'Connor & Joffe, 2020). For this study, an experienced researcher with a doctoral degree and experience conducting qualitative research was asked to double-code approximately 10% of the data and interpretations collected from the interviews performed by the primary researcher. The goal of 90% agreement in coded data was considered the most appropriate, and 80% was considered acceptable to ensure the accuracy of themes from the coding (Lombard et al., 2002).

Before reaching an agreement regarding the codes and themes, the primary researcher and the other coder conducted the data analysis using NVivo software. The other coder conducted their coding and analysis independently of the primary researcher to avoid bias in their data analysis process. The two then worked in tandem, comparing the themes, trends, and frequency counts of the data collected by the primary researcher. The data analysis process is further described later in this chapter.

Data Sources

For the purpose of providing a credible perspective on the experiences of CALL software engineers with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking) and teacher and learner fit, the researcher engaged the primary method to collect data, namely interviews. Recruitment

for the study began after the application for research was submitted to the University of Massachusetts Global IRB for review, recommendations, and approval. Following IRB approval (Appendix C), an email was sent to CALL software developers who, at the participant recruitment stage of this study, expressed their interest in participation and met all the participant criteria described earlier in this chapter.

Types of Data

Interviews

Prior to data collection, the researcher worked with an expert panel, consisting of an active CALL researcher and two foreign language educators with a doctorate degree in linguistics, to develop a list of pre-established open-ended questions designed to collect data that: (a) would contributive to answering the research questions of the study; and (b) were focused on the conceptual framework of the study that was based on Hubbard and Chapelle's CALL evaluation models, as well as to allow additional probing and clarifying questions, which could lead to unanticipated data to emerge (Patton, 2015). The interview questions focused on addressing the study's purpose and research questions regarding the experiences of CALL software developers with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking) and learner and teacher fit.

Following Brinkmann and Kvale (2018), a semi-structured interview approach was utilized to allow for flexibility and more conversational interaction with the study participants in the interview process. When designing the interview questions and collecting data during the interviews, the researcher was cognizant of the fact that the trustworthiness and authenticity of qualitative data lie in using appropriate questions

reviewed by the panel of experts as well as through the implementation of efforts to ensure the reliability and validity of the study. Moreover, the interview questions utilized in this study were developed before conducting the study and were used to structure all interviews with study participants to mitigate the potential biases associated with the interviews. All interviews were audio recorded for the development of verbatim transcripts, which were subsequently used for data analysis.

Data Collection Procedures

Recruitment

From May 31-June 4, 2022, the researcher had an opportunity to attend a virtual conference organized by CALICO, an international organization dedicated to research and development in the use of CALL. The researcher shared the topic and the scope of the study with the organizers of the conference and exchanged contacts with them. In Month 2023, upon the University of Massachusetts Global IRB's approval, the researcher reached out to the CALICO staff to send an email to CALICO members to identify the target population for this study. Consequently, the target population was identified based on the email sent out by the CALICO staff to all the CALICO members with the research participation recruitment flyer (Appendix F), which included the invitation to participate in the study if they were CALL software developers and met the participant criteria. The organizer of the CALICO conference held from May 31-June 4, 2022, helped the researcher direct the recruitment flyer to proper email addresses that were stored in the CALICO membership file.

To connect with potential participants, the researcher sent personalized emails to each of the CALL software developers seeking their expertise and involvement in the

study. Additionally, the letter elaborated on the need for the study and provided specifics on the interview protocol. Once the researcher received a reply from the CALL software developer, an initial 5-minute online meeting (via Zoom, Skype, or Google Meet) was scheduled to allow an introductory session and to confirm the developer's willingness to participate in the study. Once the researcher confirmed the information and the developer's availability, the time and date for the interview were scheduled.

Interviews

Patton (2015) referred to the primary purpose of a research interview as not changing the people who are being interviewed but gathering data and "staying focused on the purpose of the interview is critical to gathering high-quality data" (p. 723). In data collection, the role of interviews is utmost because they "can become confessions, particularly under the promise of confidentiality" (Patton, 2015, p. 724). Hence, to increase the richness and depth of data, prior to conducting the interviews with the participants in the study, the following preparatory steps were taken:

1. The researcher shared the study's purpose with each participant via email or pre-interview online meeting via Zoom, Skype, or Google Meet.
2. The researcher shared the Participant's Bill of Rights (Appendix D) and the Research Participation Consent Form (Appendix E) with the participants via email. In the document, the researcher introduced the study, the criteria for participation, and the intended length of the interview, and prompted the participants to include the date and time of their availability for the interview. The researcher shared his contact information and invited the participants to ask additional clarifying questions regarding the study. The participants

signed the form and returned it to the researcher via email. The researcher acknowledged the receipt of the forms from each participant and followed up on their emails to confirm the date and time for the data collection interview.

3. Additionally, each participant received a 72-hour notice and a 24-hour email reminder. If the interview was arranged to be conducted via Zoom, an invitation link was provided to the participant ahead of time. Both the notice and the email reminder were accompanied by an invitation to participate in the study with an overview of the study, its purpose, and the data collection interview protocol (Appendix A).

After the preparation steps, between May 2023 and June 2023, the researcher conducted the interviews. To conduct interviews, the researcher followed procedures for all participants per the institution's IRB requirements. Additionally, on interview days, the following protocols were observed:

1. At the time of each interview, before starting the recording, the researcher reviewed both the nature of the study and the rights of the interviewee. The researcher reminded the interviewee of the voluntary nature of their participation in the study and emphasized their right to stop the interview and/or to take a break at any time during the interview.
2. The researcher provided an open time for the interviewee for any questions before starting the recording.
3. Interviews took approximately 30 minutes, starting with the scripted interview questions. The researcher asked follow-up questions when applicable. The

interviews were recorded using the Audacity 3.1.1 program. A backup recording was also made using the iPhone iOS Voice Memos application.

4. After the interview, the researcher thanked the interviewee and explained the next steps of the study, including a thematic analysis of interview transcription to identify themes and the revision of themes for accuracy.
5. The researcher sent the audio files to the Otter transcription serviceFor transcription.
6. To guarantee accuracy, the researcher cross-referenced the audio files with the transcriptions once the transcription service company completed them.

Data Protection and Control

The researcher took comprehensive steps to protect data and avoid any confidentiality breaches. First, each interview was recorded with the permission of the interviewee(s). Second, to protect the participants, no personally identifiable information was obtained or referenced. Each participant was assigned a letter to further guarantee data protection and control, e.g., Participant A. Third, the recorded interviews and the transcriptions were kept on a flash drive in a locked filing cabinet in a locked office, to be destroyed in 3 years. Only the researcher had access to the files.

Data Analysis

The researcher used Braun and Clarke's (2012) six-step thematic analysis protocol to identify themes. The coding approach used by both the primary researcher and the other coder was that of initial coding, axial coding to group and refine codes, and patterned coding to develop the themes, guided by Saldaña (2021) and in alignment with Braun and Clarke. Based on Braun and Clarke, the three primary steps were followed for

the data analysis process. NVivo software was used to support the coding and data analysis process:

1. Scanning the codes for themes. More specifically, the researcher reviewed the themes of codes in the alignment of the research question and the conceptual foundation underpinning the study: Hubbard and Chapelle's CALL software evaluation models on which CALL is based.
2. Coding for frequencies. Initial codes were developed (open coding and axial coding based on identified patterns following Saldaña [2021]). Then, the identified themes were reviewed for accuracy and appropriateness for the data. NVivo software was used to identify the frequency by which codes appeared. The strength of a possible theme emerging from the code was determined by its frequency.
3. Analyzing themes and frequencies. Information obtained from the codes, themes, and frequencies was used to analyze and have an in-depth look into the data with respect to how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking).

Limitations

Limitations are particular features of the study that may adversely affect the results or the researcher's ability to generalize the findings. All studies have some limitations, and it is important that the researcher is being transparent in their willingness to address these limitations (Roberts & Hyatt, 2020). The following limitations of this study were considered and mitigated by the researcher:

1. Researcher as an instrument of the study: In this study, the researcher played a key role in data collection, interpretation, and presentation. In studies where "the researcher is as an instrument," the researcher defines the meaning of data at all stages of the research process (Corbin, 2021, p.12). The researcher as an instrument of the study can be a limitation of the study. However, precautions were taken to reduce researcher bias through subjectivity, including personal assumptions. It was paramount for the researcher to acknowledge the perspective he brought into the study because he is a foreign language educator, and his professional qualifications and personal beliefs could affect his data interpretation. To ensure that his assumptions did not influence research outcomes, the researcher addressed possible biases by preparing for interviews and developing interview and sub-interview questions with the expert panel described earlier in this chapter.
2. Self-reported data: This qualitative study utilized structured and semi-structured interviews. The participants self-reported the data throughout the interviews, which is a limitation. The researcher addressed this limitation by increasing the number of interviews to 17, which improved the validity of the study.
3. Time: As with any qualitative research, data gathering was time-consuming, which presented a limitation. The researcher spent significant time collecting personal opinions, perspectives, and experiences from the participants in the study. To ensure that the data analysis was comprehensive and accurate, the researcher allocated sufficient time to the process. Additionally, the researcher

employed double-coding strategies with peer research to check the quality of the data analysis.

Summary

The purpose of this chapter was to help the reader understand this research, as well as or enable a future researcher on CALL to extend this descriptive research. The purpose of this qualitative descriptive research was to examine how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking). The research question and design helped focus on the participants' experiences. The data collection and the procedures for data analysis were described and explained in depth. Chapter IV will outline and explicate the results of the findings from this study.

CHAPTER IV: RESULTS

Overview

This chapter contains the results of the thematic analysis of the 17 interviews with the participants. This qualitative descriptive study aimed to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. The researcher used NVivo14 by QSR to help organize and code the interview transcripts; the software helped determine the hierarchy of themes based on the number of participant references coded under them. In this chapter, the researcher will first restate the purpose statement and the research questions. Next, this chapter includes a discussion of the research methods and data collection procedures, followed by a description of the population and sample. Next, the chapter provides a description of the demographic data, which is followed by a presentation and analysis of data. The chapter concludes with a summary and introduction to Chapter V.

Purpose Statement

The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit.

Research Questions

The following research questions guided this study:

1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking?
2. How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?
3. How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?

Research Methods and Data Collection Procedures

A qualitative methodology was selected for this study, which sought to explore and describe a phenomenon rather than explore the numeric relationship between variables. Specifically, a descriptive design was adopted. Qualitative descriptive studies allow the researcher to use a naturalistic approach and do not require adherence to any one theory or conceptualization (Creswell & Creswell, 2018). Instead, the description of the phenomenon developed in qualitative descriptive research should focus on presenting and describing the phenomenon in-depth.

Semi-structured interviews were used for data collection. To conduct interviews, the researcher followed procedures for all participants per the institution's IRB requirements. At the time of each interview, before starting the recording, the researcher reviewed both the study and the rights of the interviewee. The researcher reminded the interviewee of the voluntary nature of their participation in the study and reminded them of their right to stop the interview and/or take a break at any time during the interview. The researcher provided an opportunity for the interviewee for any questions before starting the recording. Interviews took approximately 30 minutes, starting with the

scripted interview questions. The researcher asked follow-up questions when applicable. The interviews were recorded using the Audacity 3.1.1 program. A backup recording was also made with the iPhone iOS Voice Memos application. After the interview, the researcher thanked the interviewee and explained the next steps of the study, including a thematic analysis of interview transcription to identify themes and the revision of themes for accuracy. The researcher used the web-based audio transcription service provided by Otter.ai. To guarantee the accuracy of transcriptions, the researcher cross-referenced the audio files with the transcriptions once the transcription service company completed them.

Population

The population of the study comprised active members of CALICO, an international organization dedicated to research and development in the use of CALL. The total number of CALICO members on March 24, 2022 was roughly 1,732. The target population for this study consisted of CALL software developers who met the following three criteria:

1. Proven experience: Participants in the study were expected to have at least 3 years of CALL software development experience at the time of research.
2. Active CALL software development practice: Participants in the study were expected to be actively developing CALL software at the time of research.
3. Client recognition: Participants' software had to be recognized by CALL software practitioners (language educators, language lab directors, etc.). This recognition was determined by the number of positive reviews and higher ratings on the Apple Store and Google Market.

Sample

Seventeen active CALL software developers, widely recognized around the world, made up the sample of the study. Sample members were invited to participate in the interviews, which were conducted from May-June 2023. Table 3 also shows the timelines when the interviews were conducted.

Table 3

Participant Demographics

Participant Number	Role/ Position	Years in Position or Industry
Participant 1	Co-Founder; CEO	8 years
Participant 2	Founder	5 years
Participant 3	Co-Founder; CEO	CEO since 2022
Participant 4	Co-Founder; CEO	3+ years
Participant 5	CEO	3 year
Participant 6	Founder, CEO	9 years
Participant 7	Developer	10 years
Participant 8	Co-Founder	10 years in the field
Participant 9	Co-Founder	3+ years
Participant 10	Managing VR Program	Around 10 years
Participant 11	Co-Founder	3 years
Participant 12	CEO and Co-Founder	3+ years
Participant 13	Founder	10 years
Participant 14	Co-Founder	3+ years
Participant 15	Developer	3+ years
Participant 16	Research Manager	3+ years
Participant 17	Managing VR Program	4 year

Demographic Data

A total of 17 CALL software developers participated in the interviews for the current study. These 17 CALL software developers exhibited their proven experience with at least 3 years of CALL software development experience at the time of the study. Additionally, participants were active CALL software development practitioners. Finally, participants' software had to be recognized by CALL software users; the number of

positive reviews and higher ratings on the Apple Store and Google Market determined this recognition. Table 3 displays a complete breakdown of the participants' backgrounds. Out of the 17 participants, three were founders, seven were co-founders or chief executive officers (CEO), two were developers, and others were managers. Those with an experience of at least three years were selected for participation. Each participant had a minimum of 3 years' experience.

Presentation and Analysis of Data

To generate the themes from the participants' interviews, the researcher applied Braun and Clarke's (2012) six-step thematic analysis to identify themes. The coding approach involved the initial coding, axial coding to group and refine codes, and patterned coding to develop the themes, as guided by Saldaña (2021) and aligned with Braun and Clarke (2012). Meanwhile, NVivo14 software was used to support the coding and data analysis process. The researcher identified major findings as the themes with the most frequency or participant references per research question; these are also considered the key findings of the research study. With the completion of the thematic analysis, all three research questions were addressed. Under the first research question, two themes were uncovered. The second research question also yielded two themes. Finally, two themes emerged for the final research question. In total, 237 response excerpts were assigned to 60 codes. The codes were then combined to form six themes. The themes for each of the three research questions are presented subsequently.

RQ1. How Do Call Software Developers Identify and Describe Their Experiences with Developing Call Software in the Context of the Four Language Competencies: Reading, Writing, Listening, and Speaking?

The first research question of the study explored how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking. The analysis showed that 11 of the 17 interviewed developers typically combine varying competencies (with a maximum of two competencies) in their programs. Among the four competencies, speaking competency was the primary skill present and targeted by the participants. Seven participants added that they implement continuous testing and evaluating the language competencies mainly by integrating teacher and learner feedback. Furthermore, six participants provided a breakdown of the important elements of speaking competency, including accommodating both native and non-native speakers, focusing on presentational and interpersonal speaking, performing oral proficiency interviews, and performing speaking exams. Five participants noted the importance of maximizing the power of technology, whereas four participants shared that they try to integrate all four competencies into their programs. One participant incorporates three competencies. Table 4 displays the complete breakdown of the themes in response to the first research question.

Theme 1: CALL Software Is Usually Developed to Combine Different Competencies (Combining Two, Three, or All Four Competencies)

The first theme of the study reflects that the participants often develop CALL software to combine at least two competencies. For 11 of the 17 participants, speaking

competency is the most critical competency. They build apps that integrate the users' speaking skills and abilities with another relevant competency such as reading, writing, or listening. At the same time, the participants shared the different strategies and issues involved as they developed their software in order to improve the users' speaking and other relevant skills.

Table 4

Themes for Research Question 1

Research Question	Themes	Sources	Frequency
RQ1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking)?	CALL Software is Usually Developed to Combine Different Competencies (Combining Two, Three, or All Four Competencies)	11	16
	CALL Software Developers Implement Continuous Testing and Evaluating of Key Elements of the Language Competencies	12	13

Overall, the participants spoke about integrating two, three, and all four competencies with their apps. First, the participants talked about developing an app that integrates speaking and reading competencies. For the interviewed developers, speaking and reading are interrelated elements of language communication. Participant 4 shared how their application enables learners to practice their pronunciation and other fundamental aspects needed to learn Chinese characters and words. In the process, users or students also integrate reading and speaking skills. Participant 4 shared how their flashcard app integrates reading (the building blocks of Chinese characters and words) with speaking practice.

In particular, in terms of speaking and reading competencies, participants also believed in maximizing opportunities for interaction between native speakers and

learners. According to the study participants, it is crucial to consider the efficiency of the software, especially the actual conversations that could be conducted between the native speaker and learner in their application or software. Participant 7 noted that they developed the software with opportunities to practice both listening and speaking, combined, through interactions between native and non-native speakers.

The participants also talked about integrating speaking and writing competencies in their software programs, highlighting how the users' overall competency improves with the application of the writing activities because these activities could help users retain information and aid in their learning. As Participant 11 pointed out, along with speaking, writing significantly helps in learning a new language because learners not only develop the ability to speak but also learn to read and write the characters as well. Participant 11 stated, "That's why we do not replace handwriting in their lessons on time. We just help them to revise to memorize the characters more efficiently." With the focus on developing software that integrates both speaking and writing competencies, Participant 9 shared how they also use speaking and writing simulators to help their users or learners practice and improve their language speaking and writing skills, while also noting the challenges associated with doing so. In the process, for further improvement, the users receive feedback. Moreover, Participant 16 decided to integrate speaking and listening with the goal of enhancing their learners' interpersonal skills. At the same time, this participant explained that with their application having VR as a tool, reading and writing are not suitable and applicable, stating:

> I would say we are primarily focused on speaking, and then within that, of course, listening because that's the hard part of that. So, we're really focused on

> developing interpersonal communication skills. We don't really do reading and writing because VR is actually not suited for that. I will say that students will read some things in class like, a sentence or like a phrase, but they're not going to read a text or a passage.

Other participants also commented on the importance of combining competencies. For example, Participant 17's software heavily uses a VR tool. This participant provided the following examples of how they apply and integrate the speaking and listening objectives while making the learning activities level appropriate with respect to the learner's proficiency in the language:

> I would say that the two main competenc[ies] … our program … focuses on [are] speaking and listening. That's because students and teachers go into the VR program together and explore a cultural landmark of their target region. They talk with each other about what they're seeing. They're listening to what each other says, and also to some supplemental audio components as part of the VR module. For the speaking challenges, I would say one of the main challenges is designing modules with activities that can scale up or down according to a student's level. We tend to design modules around the One Plus or Two level and then train the teachers to target their questions to the student's level. So, a student with a lower level, could do the same module that a student with a higher level is doing, as long as the tasks that they're expected to do in the VR environment are suitable for their levels.

Furthermore, Participant 5 offered the strategy of focusing on grammar, vocabulary, reflection, and feedback. This participant strives to explore and try other

methods and practices that could best develop the learner's speaking and listening competencies. Participant 5 also noted how whereas the main focus of their program is the user's speaking and listening abilities, other competencies are also touched on in the process, stating, "The app does provide input in the form of listening and reading. After they listen to a text, they can also listen and read at the same time."

Additionally, Participant 12 shared how they combined language competencies as they developed their software, which was unique and specific due to their target audience (i.e., children). This participant stated, "We started by building a speaking tutor, and we focused on two skills: speaking and listening." Participant 12 identified the challenge of using voice recognition with children learning English because current voice recognition solutions do not work well to adjust to children's accent.

Furthermore, the participants spoke about integrating reading and listening competencies with their software program. For Participant 2, their goal is to create a software application or tool that teachers could use in their lessons, helping them develop their students' reading and listening abilities. The participant commented: "We provide the vessel for the teachers to create reading activities or listening activities. We have a multiple-choice function where the choices can be media, but it's not core to the product." Whereas Participant 2 talked about developing a software app that combines only two competencies, namely reading and listening, others spoke about developing software app that combines at least three of them. With regard to combining three different competencies, namely reading, speaking, and listening, Participant 5 stated:

> So, initially, I wanted to provide students the opportunity to talk in pairs. So, speaking definitely is one of my main goals with this app. But then later on, I also

> expanded the app to include what I call solo tasks that they could do on their own. And this involved listening as well as reading. Students don't really need to produce written language, but with the expansion, I also provide models for essays that they can analyze and learn from.

Theme 2: CALL Software Developers Implement Continuous Testing and Evaluating of Key Elements of the Language Competencies

The second theme under the first research question highlighted the implementation of continuous assessments to improve the software as participants or developers work to enhance their users' language competencies. By performing continuous testing and evaluation of the programs for language competencies, the participants are assured that they are proactive in tracking their program's progress, identifying elements that need improvement, and ensuring alignment of their overall program goals. Participant 15 described the process of their software development in line with the integration of language competencies as "very tricky," emphasizing that they continue to develop and improve the software through data and research. This participant commented: "We try to encourage other teachers to evaluate our platform, and to do research and people have done that, you know." Meanwhile, Participant 16 shared that they also perform surveys, assessments, and analyses, along with their collaboration with universities for further research and development, stating:

> So, we'll do different member surveys, different member assessments, different analysis of classes and how they're going. I oversee all of that and then I also oversee all of our external research partners as well. We have 25 university research partners. We're all working on a variety of projects.

Participant 3 described how they use and maximize powerful tools to be able to extract insights and make predictions from their data when performing testing and evaluating vital elements of the language competencies.

As part of implementing continuous testing and evaluating of the language competencies, the participants spoke about needing to integrate feedback from both teachers and learners. They shared how they needed to ensure that the primary users, such as the teachers and learners, provided relevant feedback on their programs. However, Participant 12 acknowledged that they are still in the process of collecting data from both students and teachers upon realizing the importance of their insights. This participant highlighted the value of the users' comments and suggestions because they are honest and straightforward and help with evaluating the key elements of the language competencies, stating:

> I guess that you're asking about feedback, and I would love to have more from learners. I have been using it myself, and I don't think I need to have more information so far. For example, I'm using it this semester for my class, and one student told me, oh, I have been using it a lot because it's so helpful for my vocabulary. Vocabulary is not my intention. Yes, in each task, I have some vocabulary instructions very short before they complete the task, so I can utilize that. So, I have some kind of anecdotal feedback like that. Another thing is I already mentioned collaborating with teachers to add more content. That's definitely adding other supplemental services like tutoring, coaching, things like that.

The speaking competency was the developers' most used and applied skill in their respective programs. With this, specific practices and applications were determined as well, including accommodating both native and non-native speakers. The participants reiterated the importance of accommodating the skill level and conditions of both the native and non-native speakers. Participant 1 provided specific factors needed to be considered in developing a CALL program that aims to improve their users' core language competency. This participant then stated:

> So, we thought, well, we can keep all of our lessons fairly short and focused on certain objectives. Just give them another language. So, you build people's confidence and, and get them to be more confident with their speaking. We're trying to use the same technology to listen to a non-native speaker who's making up some mistakes and doesn't have the same intonation or pronunciation or tone.

To make their program or application more user-friendly, Participant 5 needed to consider different factors and elements such as the differences in the pronunciation, understanding, and abilities of both native and non-native speakers. To address this goal, Participant 5 emphasized the importance of including of both native and non-native speakers to reduce possible cognitive issues and challenges that may arise, stating:

> I live in the US. I work with so many teachers. I do know so many native - speaking teachers. So, it's not really a challenge, but usually I have to hire them to do this kind of work. And sometimes I purposefully include teachers and voices from other countries. The consideration, in terms of the user experience and the user interface is something that is really important. Usually when I develop something, I have an idea in mind of how a task goes, what activities will play

> out. But then when we try it on a screen like this, there are a lot more considerations that I need to make. To make the task user-friendly as well as not burden cognitively on the users. So, I can mention it as a challenge as well, so that it is not too easy and not too challenging as user-friendly.

Additionally, the participants spoke about the focus on the learners' presentational and interpersonal speaking abilities in their evaluation. For the participants, the two more specific competencies are critical in today's world and would greatly help meet the learners' personal and professional needs. As Participant 2 commented: "I would say presentational speaking and interpersonal speaking, which is really challenging to do from a development standpoint."

The participants also talked about performing oral proficiency interviews and speaking exams, as well as applying different practices and activities that would help develop the learners' speaking abilities. Participant 2 provided the following examples: "So, basically, speaking exams, oral proficiency interviews, targeting, for the most part, speaking competency in the beginning."

RQ2. How Do Call Software Developers Identify and Describe Their Experiences With Developing Call Software for Teacher Fit in Language Teaching?

The second research question asked, "How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?" From the thematic analysis of the interviews, eight participants indicated how they considered the "teacher fit" of their programs by developing programs that are both effective and efficient and by highlighting the critical role of teachers in language acquisition. Meanwhile, another seven participants reported their challenges and issues as

they tried to collaborate with teachers when developing their programs. Some examples include: addressing teachers' resistance (preference for the traditional method, cost, etc.), wanting to protect and safeguard their content, and questioning the integration of VR in lessons. The other major theme that emerged was related to the importance of communicating with the teachers and gathering relevant data from them. Table 5 displays the breakdown of the themes in response to RQ2.

Table 5

Themes for RQ2

Research Question	Themes	Source	Frequency
RQ2: How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?	Teacher Involvement Ensures The Developing Of A CALL Program That Is Both Effective and Efficient	15	19
	CALL Software Developers Face Resistance When Collaborating With Teachers	7	9

Theme 3: Teacher Involvement Ensures the Development of a CALL Program That Is Both Effective and Efficient

The third major theme of the study encompassed the participants' focus or target of developing a program that is both effective and efficient for the teachers, highlighting the critical role that instructors play in the acquisition of language. Eight participants talked about developing an efficient and effective program, stating that the process required careful planning, thoughtful design, and continuous improvement because they believed that teachers needed much assistance in creating practical lessons and activities that were not time-consuming given their many responsibilities. According to Participant 10, it is crucial for them to "honor" the reality and conditions that teachers face. In line with this goal, their program strives to provide opportunities for teachers to have access

to adequate resources that would reduce the time and burden in facilitating their students' language learning. Participant 10 stated:

> We're concerned about making things that honored the reality of what teachers are experiencing, giving them something that's profoundly usable, and at the same time offering a generous challenge to consider the work from a different perspective and with opportunities to implement kinds of experimentation or exploratory ways of teaching that are accessible and maybe more relevant, or devote a more significant amount of time to aspects of language learning that are relevant for learners more than what the history of the field would frame what's relevant.

Participant 15 found it imperative to help the teachers with their challenges in teaching language skills and competencies to their students. Hence, by offering new and interactive tools, teachers are able to save time and address their students' language learning needs. The participant stated:

> If you can provide an end-to-end solution, that more or less hits a teacher's pain points, even if it's not exactly what they're looking for, I think they'll be inclined to use it because it saves them time. So, we've discovered that if we offer teachers tools to create their own content, some teachers love that and they really use it a lot and others just don't have time, and they would rather have the content already made.

Similarly, Participant 2 highlighted the goal of creating a tool that would assist teachers in an effective and efficient manner. Given the lack of overall time and resources for teachers, Participant 2 believes that their software would greatly help language teachers:

> When it comes to speaking, instructors want to make it easy. Instructors don't have time. Doing speaking practice and speaking assessment is really challenging, really time consuming. So, what instructors want is something that works flawlessly, something that doesn't take more of their time and that, again, works well for them and works well for their students. We continue to be a tool support the teacher. But there's things we can do in AI, leveraging a very unique position that we have to really save the teachers even more time.

Likewise, Participant 4 shared how their application provides not only the content but also the opportunity for teachers to do more with the knowledge and time to which they now have access. The participant explained the following during the interview:

> The fundamental way that our app works is that you are providing lots of content that you could choose to learn and allowing you to select want to learn based on what is easiest for you versus a textbook, which provides much smaller amounts of content with the expectation that you learn 100% of it to very high accuracy.

Participant 8 shared that from their feedback and gathered data, teachers prefer a "frictionless experience," which indicates their desire to have a smooth and efficient experience in using tools that could support both the teaching and learning needs of both the instructors and students. At the same time, teachers wanted a simple but effective tool. Participant 8 stated:

> Teachers have told us that they want a frictionless experience. They want this to be as easy as possible. Teachers don't have a ton of time to be learning new tools that are complicated. So, they want it to be simple in terms of them, then being able to set up their classrooms, and create new conversation topics.

On highlighting the critical role of teachers in the acquisition of language, the participants spoke about their awareness of the teachers' critical role in language acquisition, given that they provide much-needed guidance and support, as well as a structured environment for learners to advance their language skills. In their responses, the participants noted the high respect and value that the participants had for the teachers and instructors as they developed their programs. According to Participant 13, it was important for them to keep the teachers in mind as they developed the program, given their knowledge in language teaching and strong ability to provide relevant and insightful feedback. The participant stated:

> One of the reasons why I wanted to work with teachers is because I know they have a lot of knowledge. Another thing that's quite useful, and one of the things that teachers provide, is discipline. There's gonna be a person who's going to check on your learning and you've got an obligation, a responsibility to do it. I knew that relying on that kind of feedback and that check, especially early on in development, would be really handy.

Meanwhile, for Participant 15, their common target is the teachers, with the aim of developing tools that could help teachers equip their students and match their language competency knowledge and needs. According to Participant 15, teachers possess the most knowledge of effective teaching methods and their students' learning preferences. This implies that teachers play an integral role in learners' language acquisition. Specifically, Participant 15 said:

> We, as a company, actually target teachers. So, we tried to provide tools for teachers to develop their own activities for their students, because we consider

> that the teachers themselves are the best people to understand what kind of activities that students want to do.

Participant 5 shared how their program evolved from targeting only parents and students to integrating teachers' voices and feedback due to the fact that teachers play a crucial role in language acquisition. The participant provided specific examples, stating:

> It's interesting that there are a lot of things that students can do independently, but usually it's better if there's teacher mediation, right, including game-based learning. So, when I designed this originally, I wanted to target just the public, parents and the students. But then later on, I realized that having teachers involved would be something beneficial in distributing the app as well as making it useful. So, I do have an educator Dashboard which allows teachers to create classes and add students, and then they can assign the tasks on the app to the students, and the students can submit their task completion, including their recording for the teacher to listen to and comment on. They can also facilitate interaction among the students in the class, for example, if they have to complete a conversation task, interactive task between two people. So, I do have the educator dashboard. I have been in writing teachers to contribute content.

Finally, according to Participant 9, not every learner can be completely autonomous. Some learners actually require the teacher's involvement and guidance when engaging with their CALL software. The participant noted, "So, we do not replace the teacher…for someone learners, maybe, they can work without the teacher, but not for all students. We can have those options in our program."

Theme 4: CALL Software Developers Face Resistance When Collaborating With Teachers

Another theme that emerged related to RQ2 was the different challenges and issues that the participating CALL software developers faced as they worked to collaborate with the teachers in the development of their programs. The primary examples were: addressing teachers' resistance (preference for traditional method, cost, etc.), wanting to protect and safeguard their content, and teachers questioning the integration of VR in lessons. Each example is discussed in detail subsequently.

Regarding addressing teachers' resistance (preference for traditional method, cost, etc.), the participants acknowledged that although they worked hard to collaborate and integrate the teachers in the process, they continued to face resistance due to the varying beliefs, preferences, and cost issues involved. As Participant 15 shared, resistance and lack of buy-in are common. However, the issues intensify especially when the software costs are known and instructors and other stakeholders even become "hostile and critical." The participant shared the following:

> There is a bit of resistance. And also, if you're offering your app for free, that's one thing, but as soon as you put a price on it, then people get a lot more, not quite hostile, but they get a lot more critical. As soon as you start asking them to pay for it, they'll start pointing out the weaknesses, so they get a lot more critical of commercial apps. And some are diametrically opposed to paying for anything. But others are more open to the idea of paying for things that they think that are gonna give them a lot of value. I will make a clear and big distinction between paid for and free apps as well.

Meanwhile, Participant 4 shared the challenges he faced in working with Chinese teachers who highly value the importance of writing Chinese characters and are on the more traditional side. The participant provided several examples, indicating:

> I would say the most challenging thing with integrating with teachers, particularly with Chinese, is there's many different ways that you can decide to teach depending on how you approach the importance of handwriting. That's not something that you're going to experience with German or Spanish or a language that has the Latin alphabet, but with Chinese that becomes a fundamental crux in the decision. So, if a teacher really values handwriting, it's going to very much increase the amount of resistance they have for any sort of software that doesn't support handwriting.

Another reason for resistance from teachers was related to their desire to protect or safeguard their lesson content and data. As Participant 7 shared, it can be difficult to acquire teachers' buy-in, especially that of the more traditional ones or those who have less trust in technology or the process that technological tool can offer. The participant stated:

> They've worked hard on their lesson design, and they want to stick with it. And us coming in saying no throw all of that away, [and] just talk to the student about their life. For some teachers can be too far to go. It just feels too unstructured. But generally, it seems to work just fine. Most people can understand the idea of personalizing it to the students. I think sometimes the teachers have a real tendency to want to translate a lot and to want to speak to the student in their English for the most part, since most of our students are native English speakers. Trying to wean those teachers off of that tendency can sometimes be difficult.

There was also resistance regarding the integration of VR in lessons when the participants spoke about the use of VR as a tool or gadgets integrated in lessons inside the classrooms. Participant 17 admitted that both teachers and students question the need for the VR program and how it could be beneficial to the learners' language development and competency. The participant then shared how:

> There is sometimes resistance. That's the whole issue with the VR program in general, is teachers. And students wonder, why do I need this? What benefit is this bringing, so there's just not that much understanding yet of the benefits of VR, even though research is starting to show that there are benefits, it's engaging, it's motivating, it decreases anxiety.

As there continue to be traditional teachers who do not accept technology integration in education, participants noted that they continue to receive critical comments and resistance from this population. Participant 9 indicated that they perform a lot of user research data gathering. However, their data gathering and research process are hindered by the critical attitude of some teachers who do not approve of their program or method. Participant 9 stated:

> We do a lot of user research. We try to find people who want to improve speaking skills and talk a lot of them. So, if we talk about how we fit to teachers, first of all, we also talk a lot with teachers and at the very beginning, they were very critical to our platform because of quality. They see mistakes in speech recognition, and they say that it's not accurate, it doesn't work. So, forget about your idea. That's why we decided to [exclude] teachers, [from] our target user because they are really critical about accuracy.

RQ3. How Do Call Software Developers Identify and Describe Their Experiences With Developing Call Software for Learner Fit in Language Learning?

The third research question explored how CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning. The analysis of the data in relation to the third research question led to two themes garnered from varying perceptions or responses shared by the 17 participants. When asked about the learner fit of the developers' programs, six of the 17 participants shared how they focused on developing content that is engaging and interactive while ensuring that a sufficient level of difficulty is present to promote learning. Another five participants emphasized the practice of providing diagnostics and instant feedback, whereas three participants shared the need to make the process as simple as possible for the learners. Finally, two participants performed pre-and post-tests with students and one participant performed significant research based on learners' needs. The themes are shown in Table 6.

Table 6

Themes for RQ 3

	Themes	Sources	Frequency
RQ3: How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?	CALL software developers focus on designing content that is engaging, interactive, and learner friendly	16	27
	CALL software developers conduct diagnostic assessment of learner's language skills, provide instant feedback to support learners, and involve significant research on learner needs	10	19

Theme 5: CALL Software Developers Focus on Developing Content That Is Engaging, Interactive, and Learner-Friendly

Ten of the 17 interviewed participants indicated that they focused on developing engaging, learner-friendly, and interactive content to enhance the learner experience and also on providing diagnostics and quick feedback to the developers. For them, engaging and interactive content promotes active participation, which could enhance students' or users' overall learning experience. According to Participant 10, they sought to develop an innovative program, one that offers an experience utilizing both virtual and augmented reality technologies. This pertains to the ability of the program to attract the students' interest and allow them to enjoy the experience but also ensure that the level of difficulty is still sufficient to promote learning. Participant 10 stated:

> The most innovative aspect of our work is developing a mixed reality experience toolkit, a bunch of different sorts of escape room type experiences that cut across analog, digital, social, game, narrative dimensions. And in those cases, the content is buried within the interactive dynamic of the world that we build. I'm not trying to offer a discrete skill. Learning objectives are more at the meta cognitive, meta linguistic, meta pragmatics. But then within some of that, there are certain language functions that are targeted.

Meanwhile, Participant 12 talked about using a game-like experience to balance both education and entertainment and create engaging content, "We are creating a game-like experience. So, you always have to balance you know, like the education and entertainment, game and learning. Yeah, definitely a challenge." Participant 8 has performed several tests and evaluations focused on maximizing AI and its integration into

the students' learning. What would contribute to student engagement as they try to learn a new language, as per the participant, is the feature in the application that allows learners to choose the tone of the conversation while practicing their speaking with the AI-operated character:

> So, we're actually going to roll out the ability for users to tell us that they want the AI to be flirty or be friendly or be sarcastic. And these are the roles that the AI is quite capable of playing. And we've done a lot of testing. That's really what we're going for and in a bit of a modular way that gives the total agency to the student or teacher in order to control that experience and provide the exact conversation environment that is going to keep them most engaged and certainly learning, learning and practicing the most.

Additionally, Participant 8 spoke about the features of their app that allow learner to provide diagnostics and instant feedback to the developers, noting how it maximizes learner engagement and interaction:

> First off, we have a rating score screen at the end of every chat. So if the user ends the chat, they have a chance of providing feedback on the comfort in that conversation. That's how we capture quite a lot of qualitative as well as quantitative feedback. Users can also submit a form can submit feedback directly, either through the chat platform, or directly from our homepage, on our website.

Theme 6: CALL Software Developers Conduct Diagnostic Assessment of Learners' Language Skills, Provide Instant Feedback to Support Learners, and Involve Significant Research on Learner Needs

The final theme entailed making the learning process as simple as possible, conducting diagnostic assessment of learners' language skills (pre-tests and post-tests), and involving significant research based on learners' needs. With respect to conducting pre-tests and post-tests, Participant 1 noted:

> You know, comparative data from the beginning to end of the unit. And hopefully, we'll see the upwards trend of pre- and post- scores showing that prior to this, they had this much knowledge, and how they had this much on average.

Participant 9 also pointed out that their software has a feature of tracking learners' progress and providing them with regular instant feedback:

> So, we research how students' progress if they do regular speaking practice. We try to measure, through our metrics, each student's outcome, it's a level. So, if they increase their level, so we think this is awesome. So, on the top, is a level where we estimate more than 30 parameters of your speech. So, vocabulary size, speed of your speech, grammar mistakes, density of your grammar mistakes and so on.

With regard to simplifying the process and reducing the duration or length of time that it takes a learner to sign up for a VR plan, and, as a result, receive feedback on their language skills faster, Participant 17 indicated:

> Our Interactive Voice Response (IVR) models are a limited part of the students' overall curriculum. So, they're often treated like a field trip, were kind of like a

> one off experience, or maybe it happens twice during their time with us at our company. So when the students are unfamiliar with the technology, that has to be weighed in. That was definitely a part of our process, especially in the beginning, it was taking like 20-30 minutes for us to onboard a student and get them to even just to connect into the virtual environment. So we've streamlined that process, so it doesn't take as much class time. And that increases the value of the students doing it because then they're not wasting 30 minutes of their precious class time to sign on to the VR plan. So now it's down to like 5 minutes, maybe 10.

As for the need to do significant research on learner fit, Participant 16 reported,

> At this point, our base platform is established, but anytime we launch a new feature, or we want to change something, there's a lot of research that goes into that to make sure that it does fit our learners' needs.

Additionally, the participant noted, "We'll also do learner research as well, testing and getting feedback on whatever feature we're implementing. We also do our internal research evaluating the efficacy of our product." Participant 4 also highlighted the need for conducting research on what the leaners really need, and shared that the features they realize in their application are based on the research:

> Our platform does not support handwriting, as a skill. And the reason we don't support handwriting is that the research suggests that it drastically reduces your rate of progress. So, we believe that the teaching of handwriting is actually one of the primary causes of poor retention rates in schools.

Lastly, Participant 5 noted the need to conduct research on the tasks that the language application offers for learners to complete, while making the language learning process

engaging, supporting learners, and providing them with the ways to see the progress they have made:

> Mostly I want the tasks to be useful and also for the learners to enjoy them, actually is a topic that I have researched. So, tasks sometimes may feel like a game. They have features that you would say a game has as well, like the interaction, there may be immediate feedback. So, trying to design tabs that are engaging, so that learners want to come back and do another task. They need to see that they make progress in completing the task. We also have history. They can look back and see what they have completed, and they can listen to the recordings again.

Key Findings

Following data collection and analysis, six themes were identified. These themes were used as key findings because they adequately address the research questions, purpose of the study, and research problem. Table 7 shows the key findings that emerged from this study. The key findings are listed in order of the highest source count to lowest. The research question associated with each key finding is indicated in parenthesis after the key finding.

Summary

This chapter presented the results from the thematic analysis of the 17 interviews with the CALL software developers. This qualitative descriptive study aimed to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. In the final chapter, the

researcher will discuss these themes concerning the literature found in Chapter II. Additionally, the recommendations, implications, and conclusions are also presented.

Table 7

Key Findings

Key Findings	Source	Frequency
1. CALL Software Developers Focus on Designing Content That Is Engaging, Interactive and Learner-Friendly (RQ3)	16	27
2. Teacher Involvement Ensures the Development of a CALL Program That Is Both Effective and Efficient (RQ2)	15	19
3. CALL Software is Usually Developed to Combine Different Competencies (Combining Two, Three, or All Four Competencies) (RQ1)	11	16
4. CALL Software Developers Implement Continuous Testing and Evaluating of Key Elements of the Language Competencies (RQ1)	12	13
5. CALL Software Developers Conduct Diagnostic Assessment of Learner's Language Skills, Provide Instant Feedback to Support Learners, and Involve Significant Research on Learner Needs (RQ3)	10	19
6. CALL Software Developers Face Resistance When Collaborating With Teachers (RQ2)	7	9

CHAPTER V: FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

Chapter V begins with a summary of the purpose of the research study, as well as research questions aligned with the problem and purpose. A detailed discussion of the study findings, themes, and supportive research is presented subsequently. The theoretical framework and empirical literature discussed in the literature review informed these findings and implications. The chapter concludes with the limitations of the study, recommendations to leaders and practitioners, recommendations for future research, and a chapter summary.

The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. Despite the benefits of CALL, challenges exist in its use for effective language learning (Gelan et al., 2018; Shadiev & Yang, 2020). The researcher utilized a qualitative descriptive study to describe the phenomenon, with a focus on presenting and describing the phenomenon in depth. Seventeen active CALL software developers answered the study's research questions through semi-structured interviews. The research questions that guided this study were:

1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking?
2. How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?

3. How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?

Felix (2001), Bangs (2003), and Arneil and Holmes (2003) have identified some key ideas of how technology needs to be incorporated into the classroom, thereby offering practical examples of how new technologies would offer potential and add value to face-to-face teaching in classroom setting. To address the aforementioned research questions, the population of the study comprised active members of CALICO, an international organization dedicated to research and development in the use of CALL. The total number of CALICO members on March 24, 2022, was roughly 1,732. Seventeen active CALL software developers, widely recognized around the world, made up the sample of the study and were invited to participate in the interviews. These were conducted in May-June 2023. The participating developers met the following three criteria:

1. Proven experience: Participants in the study were expected to have at least 3 years of CALL software development experience at the time of research.
2. Active CALL software development practice: Participants in the study were expected to be actively developing CALL software at the time of research.
3. Client recognition: Participants' software had to be recognized by CALL software practitioners (language educators, language lab directors, etc.).

Findings

Following data collection, the researcher used thematic analysis to identify seven key findings. These findings were based on the frequency count for the identified theme.

Key Finding 1: CALL Software Developers Focus on Designing Content That Is Engaging, Interactive, and Learner-Friendly (RQ3)

The finding that CALL software developers focus on designing engaging, interactive content that is learner-friendly confirms what has been discussed in the literature. Prior researchers have stressed the need to devise CALL content and tasks that seem appealing enough so that students will not only interact but also perform meaningfully. Kannan and Munday (2018) explored trends in second language teaching through ICT, such as networked learning, which enables interactive elements. Ghufron and Nurdianingsih (2021) also studied the flipped classroom approach integrated with CALL and revealed that involving learners in interactive activities helped them remain attentive. Finally, Dehghanzadeh et al. (2019) also conducted a review of the use of gamification in CALL and found that it helped maintain learner motivation under conditions of interactions between students.

This significant finding is in line with Krashen's (1982) input hypothesis, which stated that the most productive acquisition occurs through focusing on meaning rather than form. Developers create content that is engaging so as to reduce the affective filter and ensure learners concentrate on meaningful input, according to interview responses. This result broadens the scope to gain perspectives on design strategies elicited directly from CALL designers themselves. Although previous research focused on CALL use from the perspective of learners, this study offers an insider's account of how developers think about learner engagement and implement it in their various programs by means of interactive features. By highlighting the need for education and entertainment, their approach introduces new qualitative aspects to the development of engaging content

design in CALL. This finding is consistent with previous research indicating that interactive teaching methods and entertaining content are important aspects of language learning with technology. However, this study's results enhance current knowledge by providing unique insights from CALL professionals in developing their practices toward engagement and learner-centered content creation.

Key Finding 2: Teacher Involvement Ensures the Development of a CALL Program That Is Both Effective and Efficient (RQ2)

Another key finding from the participants was that teacher involvement ensures the development of a CALL program that is both effective and efficient. This finding aligns with the literature that highlights the importance of teachers for effective integration of CALL. Gelan et al. (2018) indicated that implementation of CALL tools in language classrooms requires teacher support, and buy-in from teachers is vital for the successful application of such resources. Also, Kannan and Munday (2018) argued that teacher training, as well as active participation in resource production, are requisites required for successful implementation of CALL technology. This further supports the views of participants in this study, who argued that for the need to work hand-in-hand with teachers' needs and feedback on board. The literature also describes how CALL tools should supplement rather than serve as substitutes for the instructor so as to encourage teacher fit. Long (1985) stated that technology should not replace but rather complement the teacher's role of promoting second language (L2) acquisition. This assertion corresponds to the responses of some interviewees who asserted that not all learners can study autonomously through CALL and require teacher supervision.

In addition, the results correspond with studies pointing out that from a teacher's perspective, CALL software should be user-friendly. Lasagabaster and Sierra (2003) discovered that teachers prefer CALL programs, which free them of preparation time. They also want to save their class time by doing chat sessions. Jamieson et al. (2005) also discovered that teachers preferred CALLs that they could integrate freely into their curriculum designs and regular schedules as an alternative teaching/learning modality for both students and themselves. This resonates with the study participants' feedback, who emphasized that they developed CALL to assist, not inhibit, teachers. This critical finding is justified through the literature stressing that effective teacher participation should be present in balancing active involvement in CALL development and focused design of CALL systems, which will lead to efficient language teaching for an instructor and language learning for CALL software users. The views of the interviewed developers enhance clarity on attaining teacher fit in CALL programming.

Key Finding 3: CALL Software Is Usually Developed to Combine Different Competencies (Combining Two, Three, or All Four Competencies; RQ1)

This key finding confirms what is observed in the literature about the incorporation of language skills into CALL technology. Studies show that a successful CALL package blends several language sub-competences. The survey by Ghufron and Nurdianingsih (2021) focused on a CALL program with speaking and writing skill integration in an EFL (English as a Foreign Language) writing class. In the case of combining two skills through grammar dictations, their results demonstrated that students' writing skills increased. Likewise, Đorđević (2020) created CALL software for

Legal English that integrated speaking and listening by applying voice-recorded tasks with the aid of modal verbs, thus enhancing the learner's understanding level.

This significant result expands on the work of past researchers by examining how different competencies are paired—whether two skill sets, three, or all four. This focus on speaking competency corresponds to the direction given by research in favor of speech as a central goal CALL region (Gillespie, 2020). By incorporating feedback from teachers and learners, developers are also responsive to calls in the literature for ongoing evaluation of CALL programs (Hubbard, 2006; Lasagabaster & Manuel Sierra, 2003). One of the limitations of previous research is that it has mainly attempted to integrate only two skills. This significant finding adds novel insights into how CALL programs address three or even all four competencies, illustrating the process of software development wherever multiple connected skills are involved through selective actions and tasks within.

Key Finding 4: CALL Software Developers Implement Continuous Testing and Evaluating of Key Elements of the Language Competencies (RQ1)

This key finding supports what has been mentioned in the peer-reviewed literature about CALL software evaluation and testing. Studies in Chapter 2 identified the necessity to evaluate and test CALL software continuously (Hubbard, 1988; Jamieson et al., 2005). Hubbard (1988) suggested an overall framework for CALL courseware assessment that incorporates various software elements, including user interface design, instructional design, and technical angle. This coincides with the fact that CALL software developers test significant domains of language proficiencies. Likewise, Jamieson et al. (2005) documented the various dimensions via which CALL software developers, teachers, and

students assess the functionalities of the CALL program's functionality periods. Instructional strategy and interface design, respectively, were used while conducting the evaluation process.

The results broaden previous literature by providing greater detail on which aspects of language competencies are tested and measured. Hubbard (2006) discussed the broad general testing of various features of CALL software but did not mention language skills. This significant result adds new information on the focus of testing, which should examine critical components associated with language proficiency, including vocabulary, grammar, and pronunciation. Through the continuous testing and evaluation of these particular elements within a language competency, CALL software developers can detect glitches that deprive the software of supporting sound language learning. This ongoing evaluation matches Hubbard's (2006) suggestion that CALL software should be assessed throughout its development process. Continuous assessments and testing can also help CALL software to continuously adapt to users' requirements, serving language learners effectively.

Key Finding 5: CALL Software Developers Conduct Diagnostic Assessments of Learners' Language Skills, Provide Instant Feedback to Support Learners, and Involve Significant Research on Learner Needs (RQ3)

This significant finding supports the observation made regarding scientific literature about CALL software developers' practices. Samuels (2013) addressed the diagnostic assessment of learners that aimed at evaluating students' language proficiency by referring to CALL software developers. Samuels (2013) indicated the value of determining learners' language proficiency levels before making choices regarding

appropriate CALL courseware. Gelan et al. (2018) also specified what learning analytics embedded in CALL software would be used to evaluate the learners' progress. This is consistent with the current study's results related to CALL programmers' experiences with initial assessments.

The observation that CALL software allows for immediate feedback to facilitate learning is in line with the principles of compelling CALL laid out by Chapelle (2001) and Hubbard (1988). Various studies reveal that prompt feedback in CALL can foster language learning when learners receive ample chances to practice and are provided some direction for self-correction (Mohamed & Adnan, 2020). This affirms the role of feedback as an integral role among developers within this analysis. Based on this study, learner needs research also becomes a prominent part of developers' work. Nevertheless, the literature highlights user-driven design and assessment in which learners are engaged (Jamieson et al., 2005; Lasagabaster & Sierra, 2003). Since this study investigated learner needs, the use of learners may offer other perspectives that were not captured through researcher interpretation. Therefore, this result deepens existing knowledge by contesting the developer bias and engaging with the triangulation of learners for enhancements in CALL development practices.

Key Finding 6: CALL Software Developers Face Challenges Bridging the Gap Between CALL and Traditional Language Teaching Approaches When Collaborating With Teachers (RQ2)

This key finding is in accordance with what has been established by the reviewed literature presented in Chapter 2. Buendgens-Kosten (2020) and Gelan et al. (2018) discussed the differences between CALL and traditional approaches to language

teaching. According to Buendgens-Kosten, CALL has historically faced a "monolingual problem," partly because most CALL software that ought to be developed with learners from all other languages, such as those learning English, for example, are assumed to understand only one language: English. This may create some difficulties in working effectively with the teachers of CALL tools, who might need to involve non-English language learners. Gelan et al. also identified limits in how the learning analytics of CALL products aligned to teachers' pedagogical requirements and preferences. This seems to imply that the gap between technical strategies in CALL and instructional methods used in natural settings may pose a challenge.

Tafazoli et al. (2019a, 2019b) identified further obstacles in addressing the CALL-teacher gap barriers to cooperation operating between teachers and teacher trainers that emerge from catastrophic expansion, misinterpretation using a metaphorical superimposition technique rather than for content semantics, and static viewpoints. The literature review identified that this negativity among teachers may also arise due to unfamiliarity with some of these technologies or an established belief that CALL takes away from their role as educators. However, for CALL tools designers to be able to win teachers' buy-in and incorporate them effectively into virtual teaching activities, they must develop resources in collaboration with teachers to be able to supplement to meet the teacher fit better. The literature provides more information on how variations in the perceptions of views among CALL developers concentrating on technological features while overshadowing a focus on traditional pedagogical needs can create barriers to collaboration. Filling in this gap of technology's impact on language learning is a

developmental process necessitating discussions regarding how CALL can supplement rather than replace classroom instruction.

Conclusions

The conclusions at which the researcher arrived were based on the study's research findings and connections to other literary works, which gave rise to a deeper comprehension of how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit.

Conclusion 1: CALL Software Developers Who Are Knowledgeable About Learners' Needs Are Better Able To Target Their Audience When Developing Software

This conclusion aligns with what has been described within the literature in Chapter 2. Jamieson et al. (2005) stress that any CALL software should be developed with a concentration on learners' needs and levels. Jamieson et al. reviewed the CALL software of various developers, such as teachers and students. Those CALL software developers who analyze the software's efficiency assess how well it suits learners' needs, abilities, etc. They concluded that software specifically generated from collaboration between teachers and learners on the demands of learners is more efficient than those programmed solely by developers. This finding contributes to the reasoning that has been drawn in conclusion, and the development consists of developers who are knowledgeable about learners' characteristics.

Moreover, Chapelle (2001) also brought to the forefront that contextual factors such as learner variables should guide CALL courseware design. She emphasized the

need for adjustment to suit variable levels of complexity, rate, and scope for various groups of listeners. This finding contributes to the conclusion that singling out instruction that streamlines and targets learners' profilers can have some impact in making software learning environment friendly. Okonkwo (2011) reviewed the effect of different CALL software on language acquisition. He noted that software designed to provide diagnostic along with learner customization had shown better performance in terms of learning results.

Conclusion 2: CALL Software Development Is More Effective When It Occurs in Consultation With Language Educators

This conclusion aligns with the findings emerging from the literature review captured in Chapter 2. Studies emphasized the need for cooperation between CALL software developers and language teachers. Gelan et al. (2018) explored the VITAL project, which focused on developing automatic feedback and assessment tools in second language learning settings. They found that there had to be close collaboration among researchers, software developers, and language teachers to develop adequate tools to better address learners' needs. The teachers gave the necessary pedagogical feedback that positively influenced the toolset design. This finding strengthens the conclusion that CALL software works effectively when developers consult with educators to ensure that it yields intended learning outcomes.

Likewise, Jamieson et al. (2005) assessed a CALL program from three points of view: developers, teachers, and students. The teachers pointed out problems such as not incorporating the program into their curriculum. Being involved with the problem and helping to address such issues may have helped earlier. This finding affirms that

consulting educators improves how software facilitates language instruction in classrooms. In addition, the result broadens understanding by highlighting crucial continuous consultative communication during implementation as opposed to initial participation.

Conclusion 3: Combining Language Competencies Fosters the Interconnected Nature of Language and Supports Student Learning Across All of the Language Competencies

In accordance with the literature analyzed in Chapter 2, this conclusion indicated that CALL developers should combine competencies targeting to reflect their interdependent nature and help students learn all of them. This finding conforms to and exceeds what was identified in fieldwork. In the literature review, studies drew attention to the inherent interconnectedness between language skills and competencies. Cheong et al. (2018) discovered correlations among success in integrated writing activities, listening, and reading proficiency skills. This reveals that language learning encompasses the integration of various capabilities. Similarly, Kafipour et al. (2018) took up the impact of teaching writing through a task-based language curriculum as evidence of relationships between competencies.

By focusing developer training on building multiple competencies through a collaborative learning experience, CALL designers can create blended language programs that better reflect the integrated approaches discussed in the literature. According to scholars like Krashen (1982), effective language learning encompasses all-around emergency dimensions related to the target language. By integrating learning goals into their courseware designs, CALL developers facilitate taking a more global

approach that attends to instruction holistically. From a theoretical standpoint, this conclusive behavioral result is derived from knowledge. Consequently, focusing developer training on building multiple competencies through collaborative learning can help CALL designers create blended language programs that better reflect the integrated approaches discussed in the literature. Such an approach facilitates practical management within the CALL field only indirectly, but still manages to extend boundaries through guidance provided by linking application areas to previous study outcomes tracked as a result.

Conclusion 4: Professional Development for CALL Software Developers Focused on the Key Elements of Language Competencies Would Improve the Continuous Testing and Evaluation Process

This conclusion aligns with the results of previous studies on how critical language skills are for CALL developers and, by extension, their influence. A number of studies highlight that CALL developers should have some target language proficiency in order to fully understand learner needs and develop appropriate pedagogical tools (Hubbard & Colpaert, 2019; Jamieson et al., 2005). As this conclusion suggests, focusing on language competence through professional development could, in turn, allow developers to establish a closer relationship between linguistic and instructional principles, which can be presented by software. This finding addresses some of the issues that many CALL programs lack a valid foundation in SLA (Second Language Acquisition) theory observed by Chapelle (2001) and Sharifi et al. (2018). Using this approach may help close the divide between SLA research and CALL implementation.

This conclusion resonates with earlier research, yet it also refines current knowledge by addressing the issues of testing and evaluation in connection to software development. Prior literature has systematically failed to elaborate on arguments as to how improving the language skills of CALL software developers affects continuous quality improvement (Jamieson et al., 2005). Nevertheless, it is also understandable that a more linguistically enlightened perspective would help uncover problems during evaluation that non-proficient evaluators might miss. Doing so may result in software that becomes closer to a reproduction of natural language usage and steadily meets learners' increasing needs more closely. Thus, the conclusion provides an innovative angle on ways to develop the CALL process.

Conclusion 5: Utilizing Assessment Guidelines in CALL Evaluation Will Standardize Practices and Tailor Feedback To Serve Learner Needs Better

This conclusion aligns with discussions in Chapter 2 on the need to have guidelines for the evaluation of CALL tools and software. Some of the studies presented in the literature review were explicit about standardized frameworks and guidelines for CALL evaluation. For instance, Hubbard (1988) suggested an integrated model for assessing CALL courseware evaluation. McMurry et al. (2016) also presented an evaluation schema for CALL. In the same way, Jamieson et al. (2005) touched upon using well-known evaluation standards and structures, such as those developed by Chapelle, to assess CALL tools from each of these stakeholders' points of view.

This conclusion also takes one step further than the concept presented in prior literature by clearly detailing how standardized assessment can be adapted to suit learner needs. However, no framework or model of evaluation introduced in Chapter 2 discussed

the ways that the results could then be used for designing learner experiences with CALL tools. Nevertheless, it can be logically derived that good evaluation designs with reliable accounts of learner interactions and results can provide helpful information informing software development strategies and processes. Through the integration of features and support structures built on the basis of standards-aligned evaluation techniques, CALL tools would be better at assuring that the language acquisition process is achieved as well as learner benefits are maximized. This conclusion, therefore, offers a compelling approach through which standard assessment is able to not only measure but also drive advances in the area.

Conclusion 6: The Role of Other Stakeholders, Such as Teachers, Is Crucial in Effective CALL Software Development

This conclusion confirms and expands the knowledge about this discipline discussed in Chapter 2, throughout peer-reviewed material. In Chapter 2, some studies emphasized the crucial role of teachers in using CALL software effectively. For instance, Gillespie (2020) presented a case of evaluation studies in CALL where developers, teachers, and students participated. This study highlighted the importance of teacher feedback in CALL evaluation. Also, in his discussion of CALL software evaluation principles, Felix (2001) pointed out that respondents' feedback from actual or implied consumers, such as teachers, should be included with respect to factors like usability and functionality.

The conclusions of this study about the role teachers play in CALL software development match what is found in the literature. It also validates that teachers contribute to the enumeration of software characteristics, pedagogical soundness, and

constructive feedback, as revealed by previous studies. In contrast, this study also expands our understanding by providing more focus on when teachers need to be involved in development, not only during evaluation. Improving the software's usability and effectiveness may be achieved by acquiring feedback from teachers during development to improve the ability to address practical classroom needs as well as constraints. This provides a fresh dimension to the existing literature on teachers' positive contributions at different stages of the CALL software life cycle.

Implications for Action

The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. The implications for this study are directed to policymakers, educators, and the government in improving language acquisition among learners.

Implication for Action 1: CALL Software Developers Should Conduct Research on Creating Engaging, Interactive, Learner-Friendly Apps Through Gaming, VR, Feedback, and Surveys

Building on the conclusions, one of the essential suggestions is to urge CALL developers to contribute further research regarding developing engaging apps with interactive features and learner-friendly environments (including gaming VR but also spontaneously obtaining user feedback for surveys). According to the literature, a systematic review by Dehghanzadeh et al. (2019) revealed that gamification increases motivation and engagement when used appropriately in CALL. Reinhardt (2018) also

considered the capacity of digital games to offer language learning a new level of entertainment. Similarly, Parmaxi's (2023) systematic review revealed that VR has potential in language learning by making learners more immersed and interactive when design guidelines are provided.

The recommendation also aligns with the literature outlining continuous assessment and enhancement. For instance, Gelan et al. (2018) noted that relentlessly collecting learner analytics and feedback benefited iterative evolution. Prastikawati (2019) reported positive learner perceptions of the CALL app user survey, except that these perceptions improved by 83% after implementing users' recommendations. However, goal-oriented research utilizing the strategies could contribute to achieving this recommendation to create highly immersive, learner-centric applications. Supported by continuous feedback and surveys, gaming and VR allow changing needs to be addressed and the engagement level to be maintained. Therefore, this Implication for Action aligns with the literature promoting evidence-based CALL design dealing with contextual factors to maximize learner experience and performance.

Implication for Action 2: Developers Should Provide Workshops, Trials, and Committees for Teacher Input To Help Overcome Collaboration Resistance

The conclusions highlight the crucial role of teachers in software development for CALL. One of the recommendations is to emphasize collaborative efforts between developers and teachers via workshops, trials, or committees. Workshops can encourage collaboration and help resolve reluctant behavior (Kannan & Munday, 2018). The workshops give multilateral clarification of goals and concerns (Jamieson et al., 2005). Controlled software trials in real-life classrooms allow teachers to experience the possible

viability and fit for their students' specific situations (O'Connor & Joffe, 2020). Their regular input helps the course to be improved further.

It is also advised that developers and teacher representatives form ongoing advisory committees. In essence, such committees make collaboration a culture of decision-making (Gelan et al., 2018). Instead of fighting the desire to avoid change, regular meetings would keep engagement and ownership levels alive (Odiaga et al., 2021). Collaboration problems are evident in the literature regarding teacher disconnection from software design (Chapelle, 2001). The proposed actions will empower teachers as partners through exposure, participation, and development.

Implication for Action 3: CALL Software Developers Must Ensure They Understand Language Proficiency Guidelines and Work Closely With Language Educators

The recommendations stress the need to develop software while incorporating learners' needs. An empirical understanding of this implication is that CALL developers must understand proficiency guidelines and work with relevant teachers directly. Chapelle (2001) argued that second language acquisition theory should inform the design of CALL and create a tie with pedagogy needs. Koda (2007) likewise proposed that content should be ordered in a comprehensive sequence relative to learner level. For this purpose, developers must have detailed information about frameworks such as the American Council on the Teaching of Foreign Languages (ACTFL, 2012) Proficiency Guidelines that establish benchmarks for language programs.

The literature acknowledges collaborative training between developers and educators. For instance, Arnold and Ducate (2019) presented workshops facilitating

reciprocal learning concerning methodology and technology use. Ghufron and Nurdianingsih (2021) also recorded benefits when staff developers coalesced in long-term partnerships with instructors to introduce CALL defined by the course goals. Taking action to develop expertise on guidelines and working closely with language teachers have the potential of such software not only supporting curriculum as the conclusions dictate but also increasing learning growth measured by generally accepted level standards. Taking these steps creates an environment that demands technology training to improve education aims.

Implication for Action 4: CALL Software Developers Must Attend Professional Development Events To Understand the Critical Elements of Each Language Competency

Conclusions stress that CALL developers should know learners' needs and target languages. In conclusion, developers need to engage in programs designed for professional development to learn more about language competencies. Developers' participation in conferences and workshops enables them to learn directly from subject experts. For instance, Felix (2001) highlighted the need to expose the developers of CALL programs to current second language acquisition theory and methods through conferences. Hubbard (2020) also pointed out that researchers and designers during professional meetings should collaborate and cooperate to apply the ideas of SLA principles while further assimilating technology in institutions.

In particular, acquiring competency-based knowledge is critical. Yang and Kim (2016) found that technology was more effective for reading development when it was aligned with constructivist and task-based learning paradigms. Krashen's (1982) input

hypothesis and Long's (1980) interaction theory provide frameworks for understanding key factors like vocabulary and grammar in listening/speaking. Through the focus on language professionals, developers need to spend their time and resources to engage in a vast network of skills reinforced through different activities leading to their understanding of the key elements of each language competency and, as a result, creating pedagogically-sound CALL software. This supports the literature advocating joint knowledge transfer from both domains of education and technology.

Implication for Action 5: CALL Software Developers Should Assess Learners' Language Skills Employing the ACTFL Proficiency Guidelines 2012

Based on this conclusion, CALL software developers must evaluate learner proficiency using known standards, such as the ACTFL (2012) Proficiency Guidelines, to ascertain learner fit. The ACTFL Proficiency Guidelines are the standards that summarize how language ability is demonstrated worldwide. To assess learners, as discussed in the literature, learners' current language ability need to be determined in order to design software at the right level of challenge (Krashen, 1982). Just as the ACTFL guidelines can assist developers in properly assessing learners' reading, listening, writing, and speaking proficiencies, this evaluation would then inform the software design to challenge learners and promote movement appropriately.

The literature supports setting empirical standards to determine learners' success. For instance, Krashen (1982) proposed the interpreting factor of operational language integral that should correspond to the learners' current skill level. Likewise, as mentioned in Chapter 2, Terrell (1977) supported the development of a relaxed learning

environment. So, it is paramount that all developers honor what standards like the ACTFL Guidelines suggest: giving learners the right challenges without burdening them.

Implication for Action 6: CALL Developers Must Address Teachers' Perspectives Before Embarking on the Design and Development of New Software Programs

According to the conclusions arising from the findings, it is recommended that CALL software developers consider including language teachers' views as part of value engineering that should be undertaken before they embark on designing and developing new programs. As Reinhardt (2018) stated, social interaction is another important transactional system in language learning because it enables learners to adopt and practice communicative skills. If consulting teachers from the end-user sector could be recruited to give feedback, developers could gain a sense of how to design software in a way that will promote effective interaction between the end-users. Chun et al. (2016) concluded that teacher acceptance of technology is also relevant. Instructors should be involved early to unearth pedagogical needs for buy-in. It comes down to what the literature review revealed as one of the most important factors of CALL software development: teacher fit and managing teachers' needs (Kannan & Munday, 2018). With the help of consulting teachers from the outset, developers can quickly achieve teacher fit. In addition, Bozkurt (2019) also found that technology should be seen as an instrument to support teachers and human contact rather than replace them. Such input from instructors could enlighten how the new CALL software can help teachers instead of substituting their role.

Recommendations for Further Research

Based on the findings of this study, the researcher recommends further research in the following areas in order to expand current understanding and knowledge of how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit.

1. Conduct a longitudinal study on how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. A longitudinal study would follow up on the software project for an extended period. Such a study will provide a further understanding of the long-term impacts of CALL on language learning outcomes.
2. Utilize a mixed-methods approach to understand how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. Gathering both qualitative and quantitative data will provide unique insight into the effectiveness of the CALL software. Including a quantitative component provides richer data by corroborating narrative findings with statistics, thus making the study more reliable and credible. In addition, due to the nature of quantitative data and methodological approaches, quantitative findings can be generalized to the broader population.

3. A case study approach on how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit, will give a contextual basis for the study. Through a case study, the developers will obtain insight into whether the software would work for other populations.
4. Conduct a quantitative study on how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. The statistical aspect of such a study could illuminate cause and effect of the identified variables within the study.
5. Conduct a comparative study on how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies (reading, writing, listening, and speaking), along with teacher and learner fit. This will enable the researcher to compare different CALL software programs to obtain insight into their usability, challenges, and effectiveness.
6. Investigate whether CALL software is compatible with other educational settings through a pedagogical integration. To achieve this goal, engage in a quantitative quasi-experimental design as an interventional study to examine the effectiveness of the CALL software.
7. Conduct a similar study but focus only on the CALL developers' experience developing CALL and incorporating VR and AI features. This research would

provide valuable insights into the development process, highlighting the complexities, successes, and lessons learned by CALL developers in integrating VR and AI features. By examining developers' experiences, the study can identify their challenges, such as technical limitations, resource constraints, and pedagogical considerations. Understanding these challenges can inform future development efforts, allowing developers to anticipate and address potential issues, thereby enhancing the effectiveness and usability of VR and AI-enhanced CALL programs.

Researcher Reflections

In conducting this qualitative descriptive study exploring the experiences of CALL software developers in developing language competencies, I found the insights gained to be both enlightening and valuable. Through the semi-structured interviews with 17 active developers, I was able to gather rich and diverse perspectives on the topic. The major themes that emerged from the analysis provided a comprehensive understanding of the challenges, strategies, and considerations faced by these developers in their work.

One factor that struck me was the significance of collaboration between CALL software developers and educators. The findings highlighted the importance of involving teachers in the design and development process to ensure the effectiveness and alignment of the programs with educational standards. This collaborative approach resonates with the notion that learning technologies should be developed in close partnership with those who have expertise in pedagogy and instructional design. It reinforces the idea that successful CALL software should not be driven solely by technological advancements but should also be rooted in educational principles and the needs of learners and teachers.

The themes related to continuous testing and evaluation of language competencies, as well as the emphasis on developing engaging and interactive content, provided insights into the iterative nature of CALL software development. The findings highlighted the significance of ongoing assessment and the integration of diagnostics and instant feedback to facilitate learner engagement and progress. This aligns with current trends in educational technology, where personalized and adaptive learning experiences are increasingly emphasized. It was encouraging to witness the developers' commitment to enhancing learner outcomes through innovative approaches and leveraging technology to create dynamic learning environments.

However, it became apparent that developers also face challenges in their collaborative efforts with teachers. The theme addressing issues encountered during collaboration sheds light on the complexities inherent in bridging the gap between technological expertise and pedagogical knowledge. This finding underscores the need for effective communication, mutual understanding, and shared goals between developers and educators. It also highlights the importance of creating supportive environments that foster open dialogue and encourage continuous improvement.

Reflecting on the implications for action, it is evident that various stakeholders—including educational leaders, developers, and teachers—need to work together to advance the field of CALL software development. The recommended establishment of collaborative efforts among all the stakeholders and the implementation of an evaluation protocol demonstrates the need for collective efforts to ensure the quality and efficacy of CALL software. Additionally, the call for professional development opportunities for programmers and the integration of gaming practices reflect the ongoing nature of

learning and the need for continuous growth and innovation in the field of language education.

In considering future research, the suggestion to explore the experiences of CALL developers in incorporating VR and AI features piqued my interest. As these technologies continue to evolve and gain prominence in education, understanding their integration within CALL software could provide valuable insights into their potential impact on language learning outcomes. Exploring the possibilities and challenges associated with these advanced technologies would contribute to the ongoing development and improvement of CALL software.

Overall, this study shed light on the experiences of CALL software developers and the complexities involved in developing language competencies through technology. It reinforces the importance of collaboration, ongoing assessment, and learner-centered approaches in the design and development of CALL software. By considering the experiences and insights shared by developers, educators, and learners, we can strive to create more effective and engaging language learning environments that leverage the vast potential of technology.

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APPENDICES

APPENDIX A

Interview Protocol

Thank you for taking the time to speak with me today. My name is Artem Kalyanov, and I am studying CALL software development from the perspective of CALL software developers. This study focuses on the development of CALL software for reading, writing, listening, and speaking competencies in language learning, along with CALL software's teacher fit and learner fit. I will be asking you a series of questions concerning this topic and ask that you provide your own personal experiences and perspectives.

For this study, I will be covering three research questions:

1. How do CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking?
2. How do CALL software developers identify and describe their experiences with developing CALL software for teacher fit in language teaching?
3. How do CALL software developers identify and describe their experiences with developing CALL software for learner fit in language learning?

I encourage you to share openly today, as your answers will help shape the results of my study. Additionally, with your permission, I would like to confirm that you received the Participant Bill of Rights and the Informed Consent Form. Have you had a chance to review it? Do you have any questions?

Good. Are you ready for me to start the interview?

Introduction Question

1. Could you describe your work experience and position within your company? (i.e., how did you arrive in your current position)?

CALL Software Development for Language Competencies

As mentioned, this study focuses on developing CALL software for the language competencies of reading, writing, listening, and speaking. The following questions will be specifically related to these competencies.

2. What language learning competency (reading, writing, listening, speaking) does your CALL software target? If you have experience with multiple

competencies, I would like you to focus on the 2 with which you have the most experience.

** The next questions will be based on the specific language learning competency/competencies mentioned by the interview participant in Question 2. If the participant mentions two or three competencies, appropriate questions below will be asked.*

Reading Competency

3. You have a lot of experience developing CALL software for Reading Competency. While this app/these apps focus on Reading Competency, did this app/these apps also touch on other competencies? If so, how little or how much? Please feel free to share openly and talk through some specific examples.
4. What challenges do you face when developing software that targets Reading Competency? Could you provide specific examples?

Writing Competency

3. You have a lot of experience developing CALL software for Writing Competency. While this app/these apps focus on Writing Competency, did this app/these apps also touch on other competencies? If so, how little or how much? Please feel free to share openly and talk through some specific examples.
4. What challenges do you face when developing software that targets Writing Competency? Could you provide specific examples?

Listening Competency

3. You have a lot of experience developing CALL software for Listening Competency. While this app/these apps focus on Listening Competency, did this app/these apps also touch on other competencies? If so, how little or how much? Please feel free to share openly and talk through some specific examples.
4. What challenges do you face when developing software that targets Listening Competency? Could you provide specific examples?

Speaking Competency

3. You have a lot of experience developing CALL software for Speaking Competency. While this app/these apps focus on Speaking Competency, did this app/these apps also touch on other competencies? If so, how little or how much? Please feel free to share openly and talk through some specific examples.
4. What challenges do you face when developing software that targets Listening Competency? Could you provide specific examples?

Teacher Fit and Learner Fit

Additionally, as I mentioned at the beginning of this interview, this study focuses on developing CALL software for teacher fit and learner fit. The following questions relate to your experiences developing CALL software to suit language instructors and their students.

5. **Teacher fit** [understanding what language teaching approach the software reflects to determine its compatibility with the teacher's way of teaching]:
6. Could you describe your experiences making your CALL software appropriate for teachers (addressing teacher fit)? What challenges do you face when addressing teacher fit?

7. **Learner fit:** [determination of how well the software's content and language level are learned by the student and how these fit with the learner's skills and abilities]:
   Could you describe your experiences making your CALL software appropriate for students (addressing learner fit)? What challenges do you face when addressing learner fit?

CALL Software Development Process

8. When you are developing CALL software and focusing on reading, writing, listening, speaking, teacher fit, or learner fit, how are you measuring success for the teacher and students using the software? Are there specific evaluation criteria? What frameworks or rubrics are you adopting?
9. What challenges may you have faced when working on the evaluation part of the software development?

Closing Questions

10. Is there anything I have not asked you about regarding your experience developing CALL software in the context of language learning competencies, teacher fit, and learner fit?
11. Do you have any questions for me?

APPENDIX B

CITI Certificate

Completion Date 20-May-2020
Expiration Date N/A
Record ID 36694120

This is to certify that:

Artem Kalyanov

Has completed the following CITI Program course:

Not valid for renewal of certification through CME. Do not use for TransCelerate mutual recognition (see Completion Report).

Human Subjects Research (Curriculum Group)
Social-Behavioral-Educational Researchers (Course Learner Group)
1 - Basic (Stage)

Under requirements set by:

Brandman University

Collaborative Institutional Training Initiative

APPENDIX C

IRB Approval

IRB Application Approved As Submitted: Artem Kalyanov

IR

Institutional Review Board <my@umassglobal.edu>

Friday, June 9, 2023 at 7:18 AM

To: akalyano@mail.umassglobal.edu; **Cc:** jlee1@umassglobal.edu; irb@umassglobal.edu

Dear Artem Kalyanov,

Congratulations, your IRB application to conduct research has been approved by the UMass Global Institutional Review Board. This approval grants permission for you to proceed with data collection for your research. Please keep this email for your records, as it will need to be included in your research appendix.

If any issues should arise that are pertinent to your IRB approval, please contact the IRB immediately at IRB@umassglobal.edu. If you need to modify your IRB application for any reason, please fill out the "Application Modification Form" before proceeding with your research. The Modification form can be found at the following link: https://irb.umassglobal.edu/Applications/Modification.pdf.

Best wishes for a successful completion of your study.

Thank you,
Doug DeVore, Ed.D.
Professor
Organizational Leadership
IRB Chair
ddevore@umassglobal.edu
www.umassglobal.edu

APPENDIX D

UMass Global University Institutional Review Board

Research Participant's Bill of Rights

UMASS GLOBAL INSTITUTIONAL REVIEW BOARD Research

Participant's Bill of Rights

Any person who is requested to consent to participate as a subject in an experiment, or who is requested to consent on behalf of another, has the following rights:

1. To be told what the study is attempting to discover.
2. To be told what will happen in the study and whether any of the procedures, drugs or devices are different from what would be used in standard practice.
3. To be told about the risks, side effects or discomforts of the things that may happen to him/her.
4. To be told if he/she can expect any benefit from participating and, if so, what the benefits might be.
5. To be told what other choices he/she has and how they may be better or worse than being in the study.
6. To be allowed to ask any questions concerning the study both before agreeing to be involved and during the course of the study.
7. To be told what sort of medical treatment is available if any complications arise.
8. To refuse to participate at all before or after the study is started without any adverse effects.
9. To receive a copy of the signed and dated consent form.
10. To be free of pressures when considering whether he/she wishes to agree to be in the study.

If at any time you have questions regarding a research study, you should ask the researchers to answer them. You also may contact the UMASS GLOBAL Institutional

Review Board, which is concerned with the protection of volunteers in research projects. The UMass Global Institutional Review Board may be contacted either by telephoning the Office of Academic Affairs at (949) 341-9937 or by writing to the Vice Chancellor of Academic Affairs, UMASS GLOBAL, 16355 Laguna Canyon Road, Irvine, CA, 92618.

UMass Global IRB	Adopted	2021

APPENDIX E

Informed Consent Form

INFORMATION ABOUT: Software Developers' Experiences with CALL in the Context of the Four Language Competencies (Reading, Writing, Listening, and Speaking) and Teacher and Learner Fit

RESPONSIBLE INVESTIGATOR: Artem Kalyanov, Ed.D. Candidate

PURPOSE OF STUDY: You are being asked to participate in a research study conducted by Artem Kalyanov, Ed.D. Candidate, a doctoral student at UMASS GLOBAL. The purpose of this qualitative descriptive study was to explore how CALL software developers identify and describe their experiences with developing CALL software in the context of the four language competencies: reading, writing, listening, and speaking, along with teacher and learner fit.
Understanding how the CALL software is developed considering these factors may help identify potential ways of improving CALL software for learner and teacher experience.

This study will fill in the gap in the research regarding CALL software development and its implications for educators, users, and software developers. While current research on CALL concentrates more on teachers' intentions, perceptions, and attitudes, this study will focus on discussing the CALL software's fit for teachers and learners. Best practices and challenges of CALL software developers will be documented so that other CALL software developers can design CALL programs that achieve both learner and teacher fit in ways that help promote core competency (reading, writing, listening, and speaking) development.

By partaking in this study, I agree to participate in an individual interview. The interview will last approximately 45 – 60 minutes and will be conducted in person or electronically using MS Teams or Zoom. Completion of the individual interview will take place June 2023 through July 2023.

I understand that:

a) There are minimal risks associated with participating in this research. I understand that the Investigator will protect my confidentiality by keeping the identifying codes and research materials in a locked file drawer that is available only to the researcher.
b) b) I understand that the interview will be audio/video recorded. The recordings will be available only to the researcher and the professional transcriptionist. The audio recordings will be used to capture the interview dialogue and to ensure the accuracy of the information collected during the interview. All information will be identifier-redacted, and my confidentiality will be maintained. Upon completion of the study, all recordings will be destroyed. All

other data and consents will be securely stored for three years after completion of data collection and confidentially shredded or fully deleted.

c) The possible benefit of this study is that my input may help add to the research regarding CALL software development and CALL software developers' experiences with CALL in the context of the four language competencies (reading, writing, listening, and speaking) and teacher and learner fit. The findings will be available to me at the conclusion of the study and will provide new insights into CALL software development in the context of the four language competencies (reading, writing, listening, and speaking) and teacher and learner fit. I understand that I will not be compensated for my participation.

d) Should you have any questions or concerns about the research, please contact Artem Kalyanov at _____and/or by phone at _____ or the dissertation Chairperson, Jeffrey Lee, Ed.D at and/or by phone at _____ (email addresses and phone numbers are removed for privacy).

e) My participation in this research study is voluntary. I may decide not to participate in the study and withdraw at any time. I can also decide not to answer particular questions during the interview if I choose to. I understand that I may refuse to participate or may withdraw from this study at any time without any negative consequences. Also, the Investigator may stop the study at any time.

f) No information identifying me will be released without my separate consent, and all identifiable information will be protected to the limits allowed by law. If the study design or the use of the data is to be changed, I will be informed, and my consent will be re- obtained. I understand that if I have any questions, comments, or concerns about the study or the informed consent process, I may write or call the Office of the Vice Chancellor of Academic Affairs, UMASS GLOBAL, at 16355 Laguna Canyon Road, Irvine, CA 92618, (949) 341-7641.

I acknowledge receiving a copy of this form and the "Research Participant's Bill of Rights." I have read the above and understand it and hereby consent to the procedure(s) set forth.

Signature of Participant

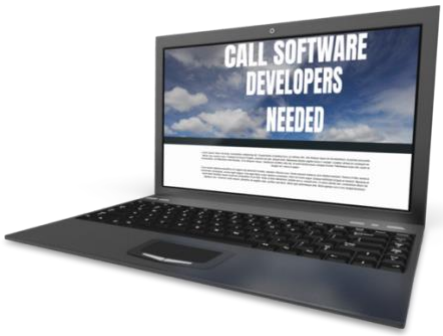
Signature of Principal

Investigator Date

APPENDIX F

Recruitment Flyer

Looking for <u>active</u> COMPUTER-ASSISTED LANGUAGE LEARNING (CALL) Software Developers!



My name is Artem Kalyanov. I am a doctoral candidate at UMASS Global.
I am looking for participants, CALL Software developers, for my study.
"Software Developers' Experiences with CALL in the Context of the Four Language Competencies (Reading, Writing, Listening, and Speaking) and Teacher and Learner Fit."
If you are an active CALL software developer recognized by CALL software practitioners, please consider participating in this study and share your experiences **<u>during a 45-minute interview via Zoom</u>**.

The study has **<u>a high potential to advance the practice of CALL software development</u>**.
If interested in participating, the first step is to click the link below and complete a short survey. <u>https://www.surveymonkey.com/r/SVFT3TY</u>

OR

If you know someone who might be interested in participating in this study, please share this post with them.
For more info, please email me at XXXXXXXXXX