

Examining Autonomy, Competence, and Relatedness in CALL: The Case of CALL Apps with the Most Active Users

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Abstract

This study examined the distribution of three basic psychological needs (BPNs) in the instructional materials of CALL apps. We followed a descriptive content analysis design to collect intermediate-level language learning materials of the five CALL apps with the (relatively) most active users: *Duolingo*, *Babbel*, *Busuu*, *Memrise*, and *HelloTalk*. The results of the deductive content analysis showed that all of the apps addressed the three BPNs and their combinations. The results also showed that while the two apps with the most active users (*Duolingo* and *Babbel*) tended to prioritize autonomy-competence-relatedness, the third and fourth apps (*Busuu* and *Memrise*) gave less priority to this combination. The fifth app (*HelloTalk*) gave mediocre attention to autonomy-competence-relatedness compared to relatedness. We concluded that, by addressing BPNs, these apps align with the features attributed to CALL in the current era where creating an L2 context for collaborative learning to develop the inter- and multicultural aspects of L2 is highlighted to help learners put their learning steps into a context where they co-construct their knowledge.

Keywords: Psychological Needs, CALL Apps, Autonomy, Competence, Relatedness

Introduction

New technologies, including CALL apps, are believed to provide various learning opportunities for L2 learners (Booton et al., 2021). However, with the continuous advancements in CALL apps, it becomes more difficult for L2 learners to select an app among the numerous CALL apps. The advancements in CALL apps have led to many investigations on the affordance of those apps in L2 learning and teaching (e.g., Alamer & Al-Khateeb, 2021; Barrett et al., 2021; Mendes de Oliveira et al., 2021; Rosell-Aguilar, 2018). Although many studies have been done to investigate the CALL apps' affordances, L2 learners' beliefs, and challenges, there have been few studies on how they address the BPNs of the L2 learners to motivate them to use the apps (Alamer & Al-Khateeb, 2021). Psychological needs are considered important in CALL since CALL is a virtual learning environment, and psychological needs are inseparable parts of every learning environment, including the virtual one (Bachman & Stewart, 2011). However, Stockwell

(2013) asserted that BPNs are mostly ignored in CALL environments, whether it is CALL apps or teachers trying to introduce CALL to their students. This ignorance can have different roots, such as psychological, methodological, and technological. Firstly, since CALL has undergone different psychological trends, such as behavioral and constructive psychologies (Beatty, 2013), the materials may have different psychological overviews. Secondly, CALL tries to address L2 teaching and learning through different methodologies and approaches, including integrated, online, and blended approaches (Hubbard, 2008); therefore, BPNs may be implemented differently. Finally, technological challenges may determine how BPNs are addressed in CALL, including in CALL apps. Addressing BPNs is critical due to their association with learners' motivation (Alamer & Al-Khateeb, 2021; Mendes de Oliveira et al., 2021; Ryan & Deci, 2020). According to self-determination theory (Deci & Ryan, 1985; Deci & Ryan, 2000; Ryan & Deci, 2020), the three BPNs are autonomy, competence, and relatedness. It is believed that learners' motivation to learn may develop when instructors and materials address these BPNs (Alamer & Al-Khateeb, 2021; Deci & Ryan, 2000). It can also be true about virtual learning environments, including CALL (Huang et al., 2019). Now that many L2 learners worldwide use CALL apps to develop their L2 learning, it is essential to see whether these apps address the BPNs to motivate L2 learners. It is why Alamer and Al-Khateeb (2021) asked a critical question of whether mobile apps can motivate learners in the L2 learning process, and they called for research to test this assumption. However, we believe that a primary step should be taken to see whether the CALL apps include the features to develop the three BPNs. Moreover, due to the importance of integration among the BPNs (autonomy-competence, autonomy-relatedness, competence-relatedness) (Durksen et al. 2016), it is pivotal to know whether CALL apps address such integrations. Therefore, we examined the CALL apps with the most active users for their autonomy, competence, and relatedness features. The study attempted to answer the following question:

How are psychological needs distributed in the intermediate-level materials of CALL apps with the most active users?

Literature Review

The self-determination theory mentioned three BPNs, encompassing autonomy, competence, and relatedness, which can motivate learners to develop, change, and promote their learning (Deci & Ryan, 2000). Deci and Ryan (1985) stated that self-determination has a direction with the quality of individuals' experience of choice, and it can motivate or demotivate them to do an action. Therefore, addressing the three BPNs in educational contexts can enhance learners' motivation to tackle the challenges of learning (Klassen et al., 2012). Furthermore, it is believed that regardless of whether the learning environment is virtual or not, the three BPNs should be addressed; consequently, the learners can be motivated to deal with the learning challenges and take every opportunity of learning (Huang et al., 2019). Consequently, since CALL tries to create a virtual learning environment for L2 learners through different tools, including CALL apps, it should consider the three BPNs to develop their motivation.

Autonomy is one of the psychological needs of any learning environment related to learners' freedom and agency to be involved in learning (Niemic & Ryan, 2009). Any

learning environments need to develop activities, materials, and tasks which engage learners in the learning process (Ryan & Deci, 2000). Therefore, this engagement can develop learners' positive perceptions of the learning environment and enhance their motivation (Jang et al., 2009). CALL apps need to address the learners' autonomy to take ownership of their learning by practicing their agency in choosing materials, the preferred modes of interaction and communication, etc. During the structural/behavioral CALL era, there was no room for autonomy in CALL apps and materials. The ignorance of autonomy during this era was because behaviorism believed in mechanical tutoring, which assumed learners were passive recipients of the materials (Beatty, 2013). The communicative CALL can be considered as the transition phase in which the learners had very limited autonomy, but it was not significant enough. Integrative CALL assumes learners as active, autonomous, and creative who can take the directions of their L2 learning (Otto, 2017).

The SDT mentions competence as another BPN. Ryan and Deci (2000) described competence as learners' ability to engage in learning activities and tasks. The way learners perceive their competence to do learning tasks can develop their motivation to learn. Learning environments need to address the prerequisites that help learners obtain the feeling of mastery, capability, and effectiveness (Ryan & Deci, 2017). For instance, involving learners in accomplishing tasks and activities to experience their mastery over them help to develop learners' competence (Faye & Sharpe, 2008). Moreover, ongoing feedback and consciousness-raising about the materials can develop a sense of competence in the learners (Bachman & Stewart, 2011). Therefore, CALL needs to address competence as a psychological need. To do so, CALL should provide a learning context where L2 learners can feel and perceive their capability in engaging in the tasks and activities. Consequently, L2 learners can find a realistic view of their competence. Different degrees of competence have always been addressed by CALL since the early structural/behavioral CALL, yet with different assumptions. The structural/behavioral CALL focused on developing learners' competence concerning language usage and not use, without addressing feedback. Hence, it can be stated that structural/behavioral CALL addressed competence mechanically (Beatty, 2013). Such mechanical addressing of competence was continued by communicative CALL, but it emphasizes learners' fluency. From integrative CALL till now, CALL has tried to address the competence of the learners by focusing on the role of their agencies in L2 learning, including raising their consciousness, evaluating their performance, and providing various types of feedback, leading to lowering their anxiety in language learning (Ali & Bin-Hady, 2019).

Relatedness is the third psychological need. Deci and Ryan (2000) described relatedness as the need to develop relationships among learners. The learning environments should provide an atmosphere where the learners find belongingness feeling to the members of that learning environment (Klassen et al., 2012). This way, addressing relatedness can lead to the transmission of learners' values, thoughts, and beliefs among the community they interact (Bachman & Stewart, 2011). When learners identify that others respect their values, their motivation develops. Relatedness can be developed through collaborative activities in learning environments where individuals can communicate their values and beliefs. Reviewing the CALL era, including structural/behavioral and communicative CALL, we recognize that relatedness was not addressed during structural/behavioral and communicative CALL due to theoretical and practical issues. Theoretically, since structural/behavioral and communicative CALL considered language as a formal structural system and a mentally constructed system,

relatedness had no position in the two eras (Rahimi & Pourshahbaz, 2019). However, with the arrival of the integrated CALL, since language has been viewed as the ability to do social interaction (Otto, 2017), more and more attention has been allocated to including relatedness in CALL. Practically, while it was not applicable for technology to provide collaborative environments during structural/behavioral and communicative CALL, it has been applicable from the integrative CALL era onward due to technological advancements.

The SDT Taxonomy of Motivation: From Amotivation to Extrinsic and Intrinsic Motivation

There is an SDT continuum of motivation (Deci & Ryan, 2000; Ryan & Deci, 2017, 2020), indicating the least to the most self-determined orientations: amotivation, extrinsic, and intrinsic motivation (Figure 1). The continuum shows different motivations reflecting various degrees of behavior or value regulation (Ryan & Deci, 2020). Such differences in the degrees of regulations lead to different internalizations of behavior. The far left side of the continuum is amotivation, referring to the state in which individuals do not intend to behave since they have no motivation. As shown in Figure 1, individuals' lack of perceived competence, lack of value, or nonrelevance leads to amotivation. Moreover, amotivation happens when individuals cannot find a sense of efficacy or control concerning the desired outcome (Deci & Ryan, 2000). When considering amotivation in CALL, we can argue that if the CALL tools, including CALL apps, do not provide the appropriate sense of efficacy and control in L2 users, leading them to be positioned in the amotivation position.

When moving toward the right side of the continuum, we reach external motivation with four regulatory styles: external, introjection, identification, and integration (Figure 1). As a regulation style of extrinsic motivation, external regulation refers to the least autonomous behaviors (Deci & Ryan, 2000) and the most controlled (Ryan & Deci, 2020). Such behaviors are the displays of external rewards or punishments. It can be argued that some CALL apps provide different types of rewards when L2 learners do a task or activity correctly. The second form of extrinsic motivation is introjected regulation, through which the behaviors can be partially internalized by internal rewards, such as self-esteem for success and avoidance of anxiety and failure (Ryan & Deci, 2020). As seen in Figure 1, attributions such as ego involvement “in which esteem is contingent on outcomes, resulting in ‘internally controlled’ regulation” (Ryan & Deci, 2020, p. 3). Here, it is critical to mention that while external regulation is interpersonally controlled, introjected regulation is intrapersonally controlled (Deci & Ryan, 2000). If CALL apps can motivate L2 learners to use the apps for the sake of external outcomes by focusing on internal feelings such as pride or success, it can be said that CALL apps develop external motivation with an introjected regulation.

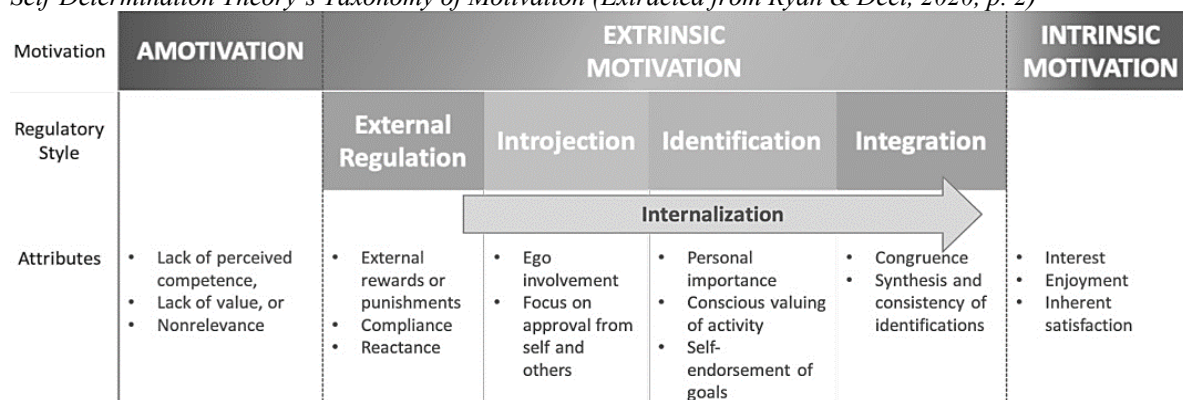
The third regulation style of extrinsic motivation with a higher degree of autonomy compared to external and introjection is identification. According to Ryan and Deci (2020, p. 3), “[I]n identified regulation, the person consciously identifies with, or personally endorses, the value of an activity, and thus experiences a relatively high degree of volition or willingness to act.” It means that individuals' consciousness is involved in regulating their motivation (Deci & Ryan, 2000). CALL apps, which can develop their users' consciousness about the task and activities they do by setting pedagogical goals,

can develop identified regulations. Finally, Integrated regulation is the most autonomous form of extrinsic motivation. According to Deci and Ryan (2000), integration happens when identified regulation is fully addressed by the self through their intrapersonal orientations. Integrated regulation overlaps with intrinsic motivation; consequently, a self-determined extrinsic motivation can be developed at this stage of extrinsic motivation.

The far-right side of the continuum is intrinsic motivation. It is believed that intrinsic motivation is associated with activities and tasks done for their inherent interest and enjoyment (Deci & Ryan, 2000). According to Ryan and Deci (2020), activities and tasks which involve exploration and curiosity can lead to intrinsic motivation since they are not dependent on external satisfaction pressures. Through intrinsic motivation, individuals can put themselves into lifelong learning (Ryan & Deci, 2017). Consequently, to help L2 learners with permanent L2 learning, CALL apps need to address the L2 learners' intrinsic interest and enjoyment. It is where the three psychological needs (competence, relatedness, and autonomy) should be combined and individualized based on the learners' preferences.

Figure 1

Self-Determination Theory's Taxonomy of Motivation (Extracted from Ryan & Deci, 2020, p. 2)



Psychological Needs in Virtual Learning Environment

It is essential to review the empirical studies about the BPNs in virtual learning environments better to understand the representations of these needs in CALL apps. Not to make it a lengthy review, we draw the main points of the studies in Table 1. Then, we discuss the critical issues.

Table 1

The Main Points of the Empirical Studies about Psychological Needs in Virtual Learning Environments

Researchers	Purpose	Main Findings	Critical Points to be Considered in CALL
Bachman & Stewart (2011)	Develop a framework for web-based courses using SDT	The direct link between psychological constructs and pedagogical principles	<ul style="list-style-type: none"> -Autonomy can be developed by supporting students to explore, -Competence can be developed by providing instructional feedback -Relatedness can be developed when students receive responses from others

Durksen et al. (2016)	Examining three psychological needs of learners participating in MOOC	The most appropriate model to include psychological needs is to encompass, first the autonomy, second the competence, third the relatedness	-The critical role of belongingness through collaboration among the learners -The importance of addressing the three needs together
Butz & Stupnisky (2017)	Developing relatedness in synchronous hybrid programs through SDT	-The development of self-efficacy of learners who participated in asynchronous discussions	-The importance of collaboration related to students' beliefs, values, etc. in the virtual learning environment
Sergis et al. (2018)	Investigating students' learning experiences in flipped classrooms through SDT	-Flipped classroom model can develop students' sense of satisfaction with their learning environment	-Collaboration can help develop the requirements for being more autonomous -Collaboration can help to develop learners' competence through doing tasks and activities -Collaboration can develop relatedness
Huang et al. (2019)	Create a model satisfying psychological needs in virtual learning environments	-Autonomy and relatedness can develop students' intrinsic motivation in 3D virtual environments. -3D virtual environments develop autonomy due to the students' need to use their agencies.	-Challenging tasks should be involved in the virtual environment to develop students' competence -The importance of addressing the three needs together
Wang et al. (2019)	To explore the relationships between need satisfaction, motivation, and outcomes and the effect of the three psychological needs	-Satisfaction of the three psychological needs leads to the development of intrinsic motivation	-The differential effects of each psychological need

There are some important points to be noted regarding the BPNs of a virtual learning environment in Table 1. Collaboration is the most common key concept. Several studies reviewed in this article indicate that collaboration can help learners develop the three BPNs (Sergis et al., 2018). It has been demonstrated that collaboration can increase learners' motivation to learn in virtual environments. Furthermore, challenging tasks can be facilitative to develop learners' competence (Huang et al., 2019). The reviewed studies remind us of instructional feedback's critical role in developing students' sense of competence (Bachman & Stewart, 2011). Besides, it is clarified through the reviewed studies that supporting learners to practice their autonomy and agencies can lead to development in their autonomy (Bachman & Stewart, 2011). Finally, it is revealed from the reviewed studies that the three psychological needs can be addressed together in different models (Durksen et al., 2016), including autonomy-competence, autonomy-relatedness, and competence-relatedness.

Psychological Needs in L2 Learning Environment

Recently, BPNs have been addressed in L2 learning environments. In a study conducted by Oga-Baldwin et al. (2017), the development of elementary school students' motivation to learn foreign languages was investigated. The researchers examined 515 elementary school students' motivation through self-reported motivation, teacher support, need satisfaction, and engagement. The results of structural equation modeling indicated that there was a dynamic interrelationship among motivation, engagement, and perception of a learning environment. Moreover, the results showed that the way instructions were delivered in elementary schools could support and enhance students' motivation to learn a foreign language. The researchers concluded their study by highlighting the important role of teachers in developing elementary school students' motivation in learning foreign languages.

Noels et al. (2019) conducted a longitudinal study to investigate 162 university students' trajectories of motivational changes and the interrelationships among BPNs, orientations, and engagement in a French language course. The results of their study indicated that the three indicators of BPNs, autonomy, competence, relatedness, and self-determined motivation developed during the semester while engagement decreased. They also found that a decrease in engagement had a direct association with the extent to which self-determined motivation developed. They concluded that the motivational characteristics of language learners might change during the academic semester.

Drawing on SDT and the self-system model of motivation, Dincer et al. (2019) investigated 412 EFL learners' classroom engagement in Turkey. Through analyzing the associations among context, self, action, and outcome by using structural equation modeling, they found that EFL learners' need satisfaction could be predicted by learners' perceptions of teachers' autonomy-support in a learning context. Moreover, learning achievement and absenteeism could be predicted by engagement. They concluded their study by arguing that EFL students' engagement could be enhanced if EFL educators follow teaching practices permitting learners to be autonomous, providing engagement opportunities for the learners, and highlighting the social nature of L2 learning.

To conduct an in-depth exploration of the relationship between language anxiety and self-determined motivation, Alamer and Almulhim (2021) followed both quantitative and qualitative research methodologies to investigate L2 learners' anxiety types and SDT-based motivational orientation. The results of their study indicated that some types of anxiety could be negatively predicted by a sense of relatedness and competence. Furthermore, the results of their study showed that general language anxiety could be positively predicted by controlled motivation. They concluded their study by providing some pedagogical implications, such as providing sufficient support for L2 learners to become socially confident, explaining the concept of competence for the learners, and reducing controlled motivation in L2 classrooms.

Elahi Shirvan and Alamer (2022) proposed a model connecting BPNs, L2 grit, consistency of interest, and L2 achievement. To develop their model, they asked Saudi undergraduate students who studied English to participate in their study. The findings of their study showed that perseverance of effort (i.e., L2 grit) could be predicted by BPNs.

Moreover, the findings of their study indicated that BPNs had a negative association with the consistency of interest. They provided some pedagogical implications based on the findings of their study. They stated that teachers should consider the students' grit to help their development. Moreover, they believed that teachers could expect grittier L2 students if they addressed BPNs in their classes.

The review of the literature concerning BPNs shows the importance of considering these needs in the L2 learning environment. When considering CALL as a learning environment whose aim is to provide facilities to open up the virtual context of learning for L2 learners, we figure out that BPNs have significant roles in such a virtual learning environment. Consequently, examining the materials provide by CALL apps for their inclusion of BPNs can be a critical start to see how CALL, as a virtual learning environment, address these needs.

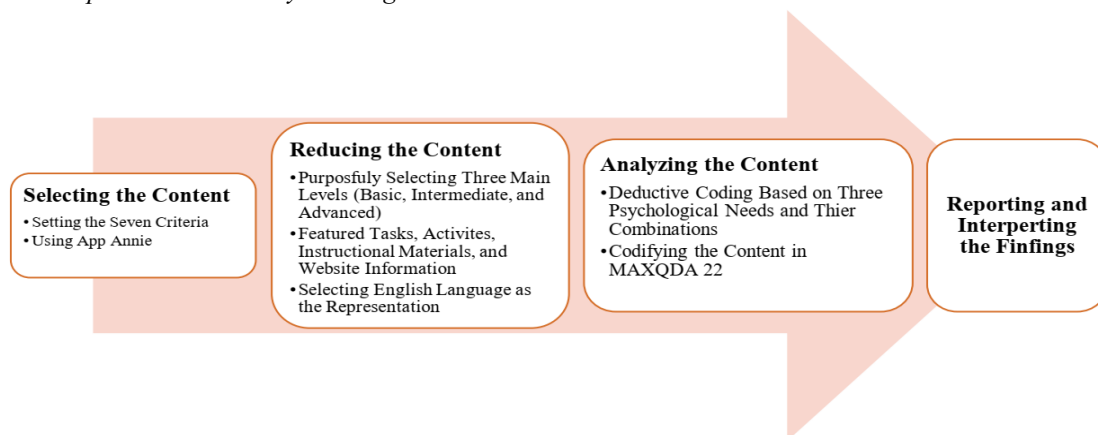
Methodology

Research Design: A Descriptive Content Analysis Design

Since the purpose of the study was to examine CALL apps to see the distribution of BPNs in their materials, we conducted a basic content analysis which allowed us “to make evaluative comparisons of materials with established standards or goals and to establish the relative emphasis within the materials” (Drisko & Maschi, 2016, p. 26). Moreover, we followed a descriptive design, one of the designs of basic content analysis, to delve into the CALL apps’ content. We needed to select and include the CALL apps following the descriptive design to reach the five apps with the most users. The criteria were seven main principles explained in the CALL app selections below.

Moreover, we reduced the content by analyzing each app’s features, activities, instructional materials, and website information at the intermediate level. Therefore, it was not our purpose and not applicable for us to examine all tasks, activities, and instructional materials for all proficiency levels (e.g., beginning, elementary, advanced, etc.). We selected and examined English in all of the apps. In the next step, we codified the content based on the three BPNs (autonomy, competence, and relatedness) and their combinations (autonomy-competence, autonomy-relatedness, competence-relatedness, and autonomy-competence-relatedness). Finally, we reported and interpreted the findings. Figure 2 indicates the descriptive content analysis design that we followed in conducting this study

Figure 2
A Descriptive Content Analysis Design



CALL Apps Selection

Due to the numerous CALL apps used worldwide, selecting the most frequently used CALL apps was not easy. Hence, we selected the most frequently used CALL apps (including mobile and web-based platforms) based on the following seven categories.

- the best **free** language learning apps
- with the features that allow learners to **learn L2 at their own pace**
- based on **ease of use and functionality**
- based on **learners' favorite**
- **in the market with the best features**
- **integrating learning into the daily routine**
- **for every learning style**

To find the best in each category, we investigated different data sources introducing the best apps from experts' points of view. Therefore, we included information from *Forbes*, *Independent*, *PCMag*, *CNET*, *Lingualift*, *ZD Net*, and *MUO*. Each of these data sources addressed one of the criteria mentioned above in 2021. After collecting the best CALL apps from the information provided by the data sources, we used *App Annie* (2021, November-December). This database helped us find the CALL apps with the most active users in November-December 2021 (data retrieved on January 13, 2022). Since we wanted to explore the five most frequently used CALL apps which had the most active users during December 2021, we put all the best CALL apps that were recommended by the seven data sources into *App Annie* (2021), then we used the *Insight Generator* tool to rank the apps based on the active users. Figure 3 shows the whole procedure of CALL app selection.

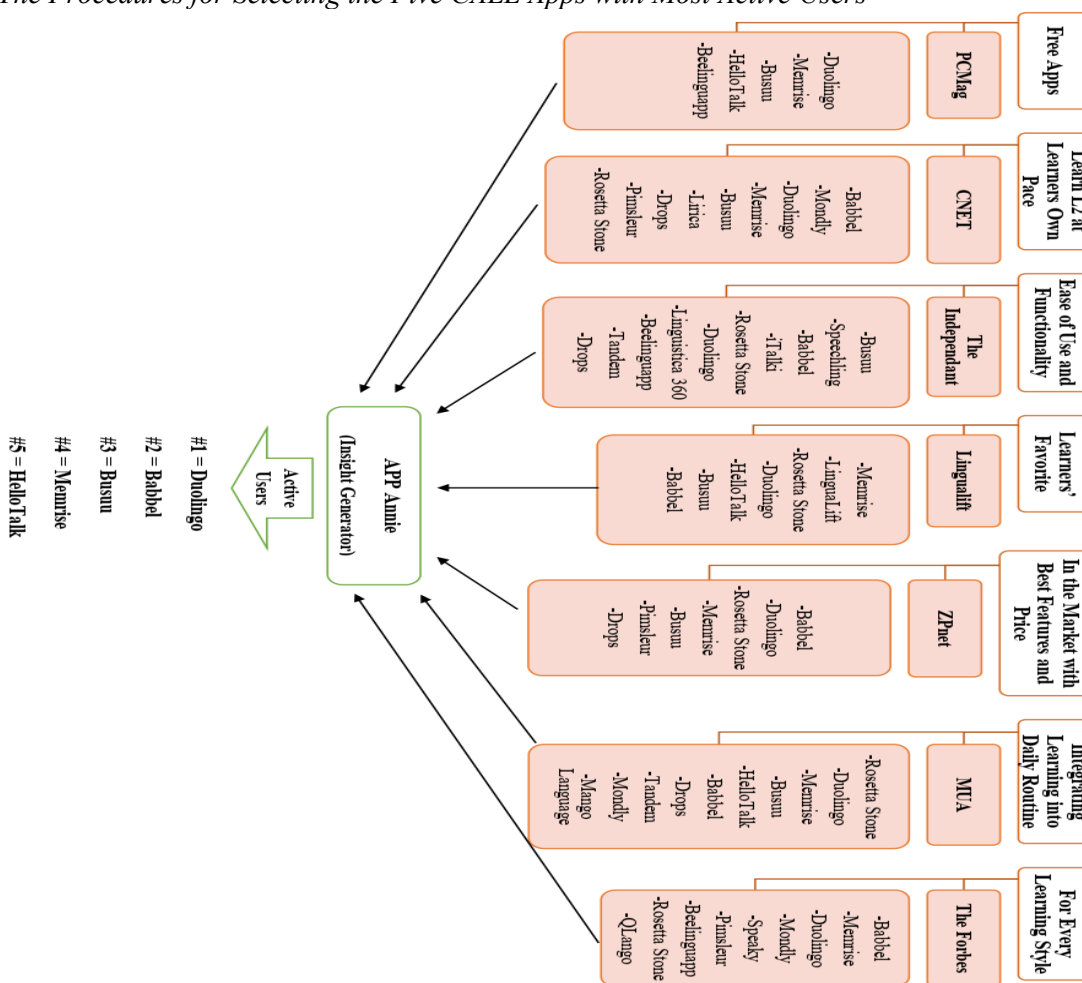
As shown in Figure 3, the five CALL apps with the most active users worldwide were *Duolingo*, *Babbel*, *Busuu*, *Memrise*, and *HelloTalk* (*App Annie*, 2021, November-December). The complete ranking of the 19 CALL apps is attached in Appendix 1. Table 2 Provides information about the five CALL apps examined in this study.

Table 2
Information about the Five CALL Apps Examined in the Study

Rank	App	Launched	Bilingual/Multilingual	Skills	Web-Based (Desktop)/Mobile App
1	Duolingo	2012	Multilingual	Four Skills	Web-Based (Desktop)and Mobile App
2	Babbel	2007	Multilingual	Four Skills	Web-Based (Desktop) and Mobile App
3	Busuu	2008	Multilingual	Four Skills	Web-Based (Desktop) and Mobile App
4	Memrise	2010	Multilingual	Four Skills	Web-Based (Desktop) and Mobile App
5	HelloTalk	2012	Multilingual	Four Skills	Web-Based (Desktop) and Mobile App

As Table 2 shows, the five apps have similar characteristics concerning the skills they address, the types of accessibility (web-based/mobile app), and their multilingual nature, meaning that they provide instructions in more than two languages. Therefore, possessing similar characteristics would increase the validity of the selection. We use the CALL app for both web-based and mobile apps for consistency.

Figure 3
The Procedures for Selecting the Five CALL Apps with Most Active Users



Data Collection and Analysis

After selecting the five CALL apps with the most active users, we created users to collect some of the tasks, activities, and instructional materials concerning the intermediate level's speaking, listening, reading, and writing skills and subskills (grammar, vocabulary, and pronunciation) for learning English through using those apps. It is worth noting that the intermediate level was identified by what the examined apps offered for the intermediate learners when they wanted to register to use the apps. All the contents were screenshotted and compiled in pdf files. It is important to note that the lead researcher made some memos beside the content to use those memos for analysis. For instance, when he could choose among the members to communicate with, he made a memo: *I was autonomous to choose my partners to communicate with/I have the opportunity to communicate with others*. This memo was directly related to autonomy and relatedness, and since they were combined in one task, they showed autonomy-relatedness. Moreover, the website information about each app was collected to help the researchers with their analysis. We then put the files into MAXQDA 22 for analysis.

To codify the content, we used a deductive coding procedure in which we used a priori (Drisko & Maschi, 2016), including autonomy, competence, relatedness, autonomy-competence, autonomy-relatedness, competence-relatedness, and autonomy-competence-relatedness. We coded the content by defining and describing each code. According to the SDT, for a learning environment to be motivating, it should include BPNs, including autonomy, relatedness, and competence (Ryan & Deci, 2017, 2020). Therefore, since we followed the SDT principles in the current study to investigate the BPNs of the CALL apps, we explored the apps for the inclusion of materials representing the three indicators of BPNs. Moreover, since the previous literature on BPNs (e.g., Durksen et al., 2016) informed us about the interconnection between and among the three indicators of BPNs, we examined the co-occurrences of them in the materials of BPNs. Hence, to operationalize the definitions of BPNs so that we could use them as a priori codes, we provided the instructions about when we codified a specific material type as representative of a specific indicator of BPNs. The following bullets are the definitions and descriptions of each code.

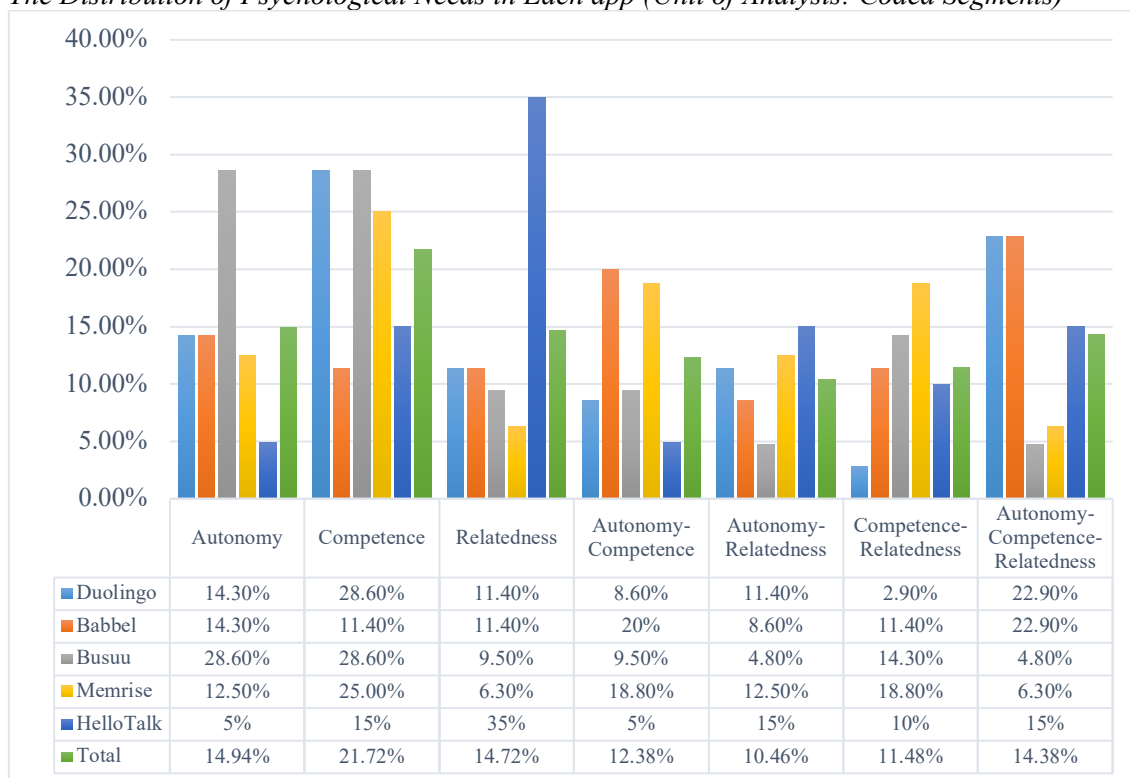
- Autonomy: The app considers student learning pace and allows learners to freely choose tasks and activities.
- Competence: The app assesses the learners, provides feedback, creates challenges, exposes the success feeling in the learners, helps learners to feel they are competent to deal with the challenges, and gives a sense of accomplishment.
- Relatedness: The app provides interaction, communication, and negotiation for the learners, develops learners' engagements, and takes into account the values of the learners.
- Autonomy-Competence (Order is not important): The app simultaneously provides opportunities for the learner to practice their autonomy and agency in choosing the tasks, activities, and materials and gives them a sense of accomplishment by evaluating them and providing feedback.
- Autonomy-Relatedness (Order is not important): The app frees learners to collaborate, negotiate, or interact with whomever they choose.

- **Competence-Relatedness (Order is not important):** The app considers the potentiality of collaboration and cooperation among users of the app in helping the learners develop their competence, deal with challenges, etc.
- **Autonomy-Competence-Relatedness (Order is not important):** This is the optimal situation in which the apps address the three BPNs together. For instance, the app provides a challenging task (competence) that asks the learner to choose somebody (autonomy) to interact with (relatedness) to help the learner accrue knowledge to deal with the challenge.

After coding the content by the lead researcher, another coder who was a PhD candidate in applied linguistics was involved in the coding procedure to address the inter-coder agreement. The lead researcher described the whole procedure for the second coder, including the coding criteria. Finally, she codified the content of two apps out of the five apps in MAXQDA 22. The inter-coder agreement provided by MAXQDA 22 was satisfactory; it was 85%. Appendix 2 shows some screenshots of the coded apps in MAXQDA 22.

Figure 4

The Distribution of Psychological Needs in Each app (Unit of Analysis: Coded Segments)



As seen in Figure 4, when put together as a total, competence (21.7%) is the most addressed BPNs by the five CALL apps, while autonomy-relatedness (10.4%) is the least addressed. Figure 4 shows *Duolingo's* intermediate-level materials addressed competence (28.6%) more than other categories. Moreover, it illustrates that *Duolingo* includes autonomy-competence-relatedness (22.9%), autonomy (14.3%), relatedness (11.4%), autonomy-relatedness (11.4%), autonomy-competence (8.6%), and

competence-relatedness (2.9%). *Babbel*'s intermediate-level materials included tasks and activities related to autonomy-competence-relatedness (22.9%). This result shows a similarity between the two apps, *Duolingo* and *Babbel*. Moreover, *Babbel*'s materials included autonomy-competence (20%), autonomy (14.3%), competence (11.4%), relatedness (11.4%), competence-relatedness (11.4%), and autonomy-relatedness (8.6%). The primary attention of *Busuu* was on autonomy (28.6%) and competence (28.6%). At the same time, the least attention was paid to autonomy-competence-relatedness (4.8%) and autonomy-relatedness (4.8%). Also, 14.3% of the materials are related to competence-relatedness, 9.5% relatedness, and 9.5% autonomy-competence. Figure 4 also indicates that *Memrise*'s included 25% of the intermediate-level materials related to competence, while 6.3% included autonomy-competence-relatedness and 6.3% relatedness. Moreover, autonomy-competence (18.8%), competence-relatedness (18.8%), autonomy (12.5%), and autonomy-relatedness (12.5%) were included in the intermediate materials of *Memrise*. Finally, *HelloTalks* prioritized relatedness (35%) more than other psychological needs. Furthermore, *HelloTalk*'s materials included 15% autonomy-competence-relatedness, autonomy-relatedness, and competence. Furthermore, 10% of the materials are related to competence-relatedness, 5% to autonomy, and 5% to autonomy-competence.

Discussion

This study was an attempt to investigate the distribution of the three BPNs and their combinations in the intermediate-level materials of the five CALL apps with the most active users. The results showed that all apps addressed the three psychological needs and their combinations (Figure 4). Furthermore, the findings indicated that the apps mostly tended to address competence and infrequently autonomy-relatedness and competence-relatedness (Figure 4). However, examining the materials of each app, one by one, showed that while the two apps with the most active users (*Duolingo* and *Babbel*) tended to prioritize autonomy-competence-relatedness, the third and fourth apps (*Busuu* and *Memrise*) gave less priority to this combination (Figure 4). The fifth app (*HelloTalk*) gave mediocre attention to autonomy-competence-relatedness compared to relatedness. The following paragraphs provide some explanations and two hypotheses for the obtained results.

The findings showed that competence was the most addressed BPN when the materials of all apps were analyzed together. One justification for this result is that CALL apps try to motivate the learners by helping them first to observe their mastery in accomplishing the tasks and activities (Ryan & Deci, 2017). This way, they can motivate them to engage in activities and tasks addressing other BPNs. Moreover, addressing the learners' competence could help them reduce their anxiety about learning a language (Ali & Bin-Hady, 2019). Anxiety is intensified in learners when their perceived competency lags behind the competency required to accomplish a task (et al., 2012). Putting these two reasons together, it seems that the CALL apps' priority is to prepare a context without anxiety for the learners and then address other BPNs. The results (Figure 4) can demonstrate evidence for this justification in that after addressing competence, the second more addressed point is the combination of autonomy-competence-relatedness. Overall,

it seems that a pre-motivating stage is required to motivate L2 learners to continue their learning through the apps. The CALL apps prefer to do it by addressing competence.

The results also showed that materials addressing the combination of the BPNs, autonomy-competence-relatedness, were the second most addressed by the five CALL apps (Figure 4). Overall, the previous studies have emphasized satisfying the three BPNs to reach learners' optimal motivation level (e.g., Niemiec & Ryan, 2009). They can intensify each other's effectiveness when addressed together (Ryan & Deci, 2020). Therefore, learners' motivation can reach its optimal level. Previously, due to theoretical, methodological, and technological issues, it was not applicable for CALL to address the three BPNs together. During the different eras of CALL, the focus has been on one or at most two of the needs. Now that L2 pedagogy considers learners' motivation as critical for their success in L2 learning (Alamer & Al-Khateeb, 2021), CALL apps do their best to develop the learners' motivation to the optimum level. One way is to prepare materials that address the three needs altogether to reach that optimum level of motivation.

The study results showed that the least attention was paid to the materials, including autonomy-relatedness and competence-relatedness (Figure 4). When pondering the results, we can observe that relatedness is present in both combinations. It is believed that relatedness can be considered the core of BPNs in each learning environment (Ryan & Deci, 2017). Thus, it is asserted to be the most difficult BPN to be addressed (Durksen et al., 2016). Therefore, one justification for the obtained results can be the difficulty in preparing materials by the apps to address, simultaneously, relatedness and autonomy and relatedness and competence. On the one hand, it can be said that creating a collaborative context (relatedness) in which learners challenge their learning and are provided with feedback (competence) is difficult to be achieved if the agency of the learners (autonomy) is ignored. On the other hand, creating a collaborative context (relatedness) where the learners can practice their autonomy is difficult since they should understand their competence to choose the right path.

Related to the argument developed in the previous paragraph about the combination of the three BPNs together in the materials are the findings of how the first two apps (*Duolingo* and *Babbel*) and the two-second apps (*Busuu* and *Memrise*) address autonomy-competence-relatedness (Figure 4). *Duolingo* and *Babbel* give higher priority to the combination of autonomy-competence-relatedness compared to *Busuu* and *Memrise*. That said, it can be hypothesized that since *Duolingo* and *Babbel* help learners reach the optimum level of motivation while learning L2 through these apps, they have achieved such ranks, as first and second, among the most active users worldwide (App Annie, 2021, November-December). However, this argument is a hypothesis that future studies should explore. The point is that since we examined the five apps with the most active users, it is not applicable to approve or reject this hypothesis based on the results of our study.

The findings also show that *HelloTalk* addresses the combination of three BPNs, autonomy-competence-relatedness, and mediocorely (Figure 4). The justification for the results is the method *HelloTalk* follows to help the users learn a language: “*Learn a language for free by chatting with native speakers around the world!*” To make it, *HelloTalk* creates a dialogue-based context where it addresses learners' autonomy (they are free to choose whom to continue with), competence (the challenges of the context, the provided feedback by native speakers, etc.), and relatedness (learners engage in communication with the native speakers). Consequently, we want to develop the second

hypothesis by saying that an app's method to instruct L2 might affect how the app addresses the three psychological needs. Further research investigating the CALL apps with the most and least active users can also test this hypothesis.

The findings call for several critical points when CALL professionals, including CALL materials developers, researchers, and teachers, try to develop and introduce CALL apps. First, when developing CALL apps, CALL materials developers need to consider the importance of including tasks and activities that address BPNs. Moreover, they have to create new apps which consider individuals' preferences concerning BPNs. Second, CALL researchers need to examine the accountability of the CALL apps in different contexts (ESL/EFL) and among L2 learners with different cultural, social, and educational levels. Third, L2 teachers should know that the CALL apps used worldwide differ concerning their attention to BPNs. Consequently, they have to analyze their learners' pedagogical needs before introducing an app to them. It is conducive to helping learners follow their needs and purposes based on appropriate CALL apps.

Conclusion and Further Research

This study aimed to examine the distribution of BPNs and their combinations in the CALL apps with the most active users in the world. The main conclusion we made through the results of the current study is that all of the five apps we examined include materials addressing BPNs, autonomy, competence, and relatedness, and their combinations, autonomy-competence, autonomy-relatedness, competence-relatedness, and autonomy-competence-relatedness. Therefore, we concluded that by addressing the BPNs, the five CALL apps try to create L2 contexts for collaborative learning where the inter- and multicultural aspects of L2 learning are highlighted to help learners put their learning steps into co-construction of knowledge. Thus, we conclude that these apps align with the features attributed to CALL in the current era (Otto, 2017).

Although some studies have addressed BPNs of CALL, we suggest that the topic needs further exploration since BPNs of CALL can find solutions for many CALL challenges, including maintaining and sustaining L2 learners' motivation. Future studies can address the students', teachers', and app developers' beliefs and perceptions about the psychological needs of CALL materials. Therefore, such studies can use other data sources, including interviews and questionnaires, to address this study's limitations. Furthermore, future studies can address BPNs from a gamification perspective of CALL apps. Moreover, further studies should examine how CALL apps with fewer active users address BPNs. One critical question is whether any significant difference exists between the CALL apps with the most and least active users in the world concerning how they address BPNs. Moreover, it should be sought whether the method a CALL app follows to help L2 learners learn languages can have any role in how the app addresses the three BPNs.

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Appendix 1

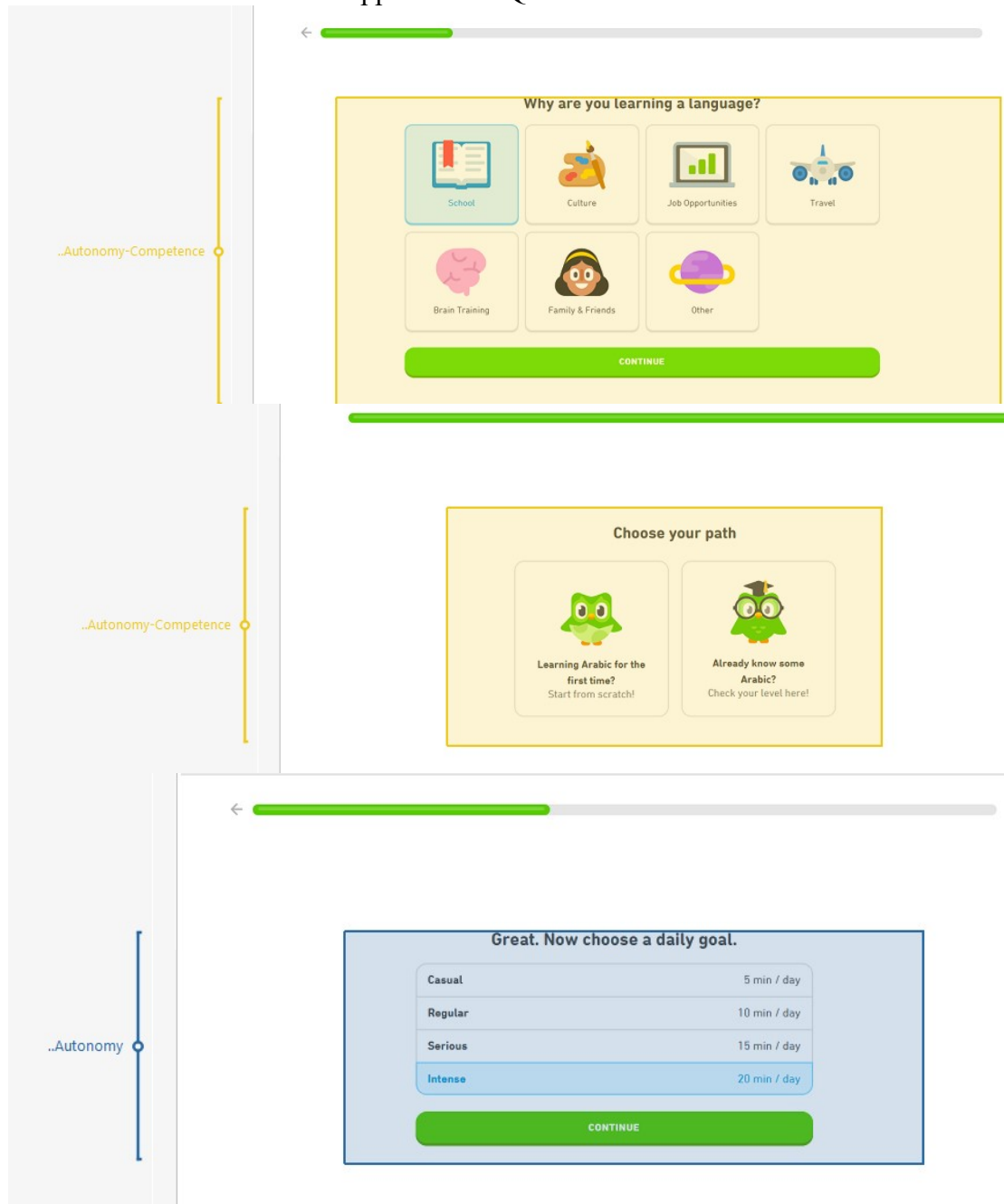
App Annie Insight Generator (2021-November-December), Retrieved January 13, 2022.

Application	Relative Active Users Rank
Duolingo: Learn Languages	1
Babbel	2
Busuu	3
Memrise	4
HelloTalk	5
Drops: Learn Spanish, English & French words fast	6
Tandem	7
Rosetta Stone	8
Mondly	9
iTalki	10
Beelinguapp	11
Speaky	12
Pimsleur	13
Linguistica 360	14
Speechling	NA
Lirica	NA
Mango Languages	NA
QLango	NA
Lingualift	NA

Note: NA means data are not available.

Appendix 2

The Screenshots of the Coded Apps in MAXQDA 22



..Competence

..Competence

..Autonomy-Competence-Relatedness

..Competence

Autonomy-Relatedness

Autonomy-Relatedness

..Competence

..Autonomy-Competence-Relatedness

Autonomy-Relatedness

..Autonomy-Competence

..Autonomy-Competence-Relatedness

..Competence-Relatedness

..Relatedness

Autonomy-Competence-Relatedness

..Competence

..Autonomy-Competence-Relatedness

..Competence

Select the correct character(s) for "da"

- My answer should not be accepted.
- The audio does not sound correct.
- One or more of the options is a duplicate.
- A character wasn't displayed correctly.
- The audio is missing.
- Something else went wrong.

Nicely done!

Statistics

- 1 Day streak
- 15 Total XP
- 0 Total crowns
- Bronze Current league

Achievements

- Wildfire** 1/3: Reach a 3 day streak
- Sage** 15/100: Earn 100 XP

Friends

- FOLLOWING**
- FOLLOWERS**

Find friends

Invite friends

Connect to Facebook