Adapting an Educational Software Internationally: Cultural and Linguistical Adaptation

Samia Valeria Ozorio Dutra 1,*; Vanessa Chee 2 and John M. Clochesy 3

1 Independent Researcher, Ilion, NY 13357, USA
2 Department of Community and Family Health, College of Public Health, University of South Florida, Temple Terrace, FL 33617, USA
3 School of Nursing and Health Studies, University of Miami, Coral Gables, FL 33146, USA
* Correspondence: samiadutra@gmail.com

Abstract: This study protocol proposes an adaptation of the participatory and iterative process framework for language adaptation (PIPFLA). The adapted model follows five dimensions for a cross-cultural equivalence model: semantic, content, technical, criterion, and conceptual. Iterative adaptations were conducted through the Delphi technique of expert consultation that comprised nursing professionals from academic, administrative, and practice fields, professional translators, and students’ online focus groups to arrive at consensus. The adapted process of PIPFLA proposed in this paper uses a standardized and transparent documentation, including expert judgment. Neither systematic reviews nor empirical research currently published describe the methodology used with enough details to allow for replication or improvement. This work illustrates innovation that takes concepts related to cultural adaptation of tools and applies these ideas to cultural adaptation of an online learning platform, based on the use of committees and codebook development strategies.

Keywords: research methodology; research design; software validation; education; cross-cultural adaptation; online learning; online pedagogy innovation; education/distance

1. Introduction

This study protocol entails a cross-cultural adaptation of an online learning platform, guided by the process and principles outlined by Brislin. Brislin’s method involves more than a literal, word-by-word translation. It includes a decentering technique that focuses on the preservation of the meaning and content of the translated text [1]. It has become more convenient, accurate, and easier to access machine translation in recent years [2], but cross-cultural adaptation of education tools is rarely found in the literature and pedagogical practice worlds. This pressing need is particularly salient regarding the design of evidence-based educational software that promulgates and disseminates adaptive, culturally sensitive products [2–5].

SafeMedicate is a web-based system based on more than 20 years of a sequential translational research process [6]. Translational research connects basic research and application in clinical practice, providing an investment return in the research landscape by improving health outcomes [7,8]. safeMedicate was designed to support the learning, synthesis and diagnostic assessment of cognitive competence in critical elements of medication dosage problem-solving [6,9]. This educational tool has recently been exposed to rigorous evaluation and assessment of the outcomes in the professional practice [10–13].

While there are teaching methods that treat students as passive recipients, safeMedicate provides a contextualized learning environment that actively engages students. This aligns with the trend of applying active teaching and learning methods in education [14] and the usage of web-based software to support teaching and research [15]. Students who use safeMedicate achieve significant improvements in the construction of conceptual and calculation competence in medication dosage calculation problem-solving (MDC-PS) in...
both the UK and USA [9,16]. Current safeMedicate educational research highlights how authentic environments engage and support all cognitive learning styles in mathematics, as opposed to traditional didactic methods of education [13,16–19]. An authentic learning environment can be defined as one that supports a spectrum of learning styles in mathematics by offering opportunities to tailor and expand mathematical skills through mental computation, arithmetic, geometry/visual, and algebra [16].

The process presented in this paper was developed for a Brazilian context and language adaptation of an evidence-based software called safeMedicate. The process of cross-cultural adaptation aligns with recent calls to action to translate and culturally adapt online interventions. This intervention should include teams with diverse backgrounds, apply iterative feedback throughout the adaptation process, and focus on long-term impact to optimize the effectiveness of this adaptation.

Moreover, in order to adapt safeMedicate for use in Brazil, it is necessary to address the health professional evaluation guaranteeing it meets the professional practice, professional regulation, and political requirements. This moves translation beyond grammatical rules and writing conventions to an interpretation informed by socio-cultural and contextual factors [20–22], making Brislin’s cross-adaptation a better fit [1]. In order to inform and guide the cross-cultural adaptation process, it is required to use a combined emic (within-culture/insider’s perspective) and etic (similarities across cultures/outsider’s perspective) [23–27]—an approach that is significance will further be explicated below.

Therefore, this research follows the theoretical base used for safeMedicate development, as well as the theoretical base guidelines for the language adaptation process.

Theoretical Base of Cross-Cultural Adaptation

Emic and etic perspectives. A series of repeated translations and back-translation exercises have been performed by a team of bilingual translators blind to the previous translation [28,29]. Nevertheless, when different languages are involved, translation and back-translation techniques are not sufficient to achieve cultural equivalency. Cultural insensitivity usually arises when experts transfer concepts across cultures uncritically and develop translations that conform exactly to the original without needed adaptations for the population for which it is being developed [23]. In order to avoid this, cross-cultural studies have been approaching the emic-etic paradigm to consider multiple linguistic and socio-cultural factors.

Initially, emic and etic were considered two different research approaches. The emic perspective is related to the attempt to explicate the phenomena’s significance from inside the system/culture, aiming to describe the internal logic or singularity of a culture. The etic perspective is a viewpoint from outside the system, fundamentally comparative, aiming to identify and compare equivalent phenomena across different cultural contexts [20,23].

However, this dichotomy limits the cross-cultural research based on the emic approach, which is limited by observation bias and lack of generalizability and the etic approach, which is limited by over-emphasis on reliability by standardizing the conceptualization at the expense of validity [20]. Therefore, some researchers aim to integrate both approaches, not viewing them as opposites, but as complimentary approaches, which provide data from two points of view [24,26,30,31]. This process is operationalized by first elaborating an imposed etic perspective, which serves as the starting point for comparative research, followed by the emic exploration of the phenomena, aiming to understand it in local cultural terms, and concluding the adaptation by utilizing the derived etic perspective, which can be discerned by following the extensive use of emic approaches in a number of cultures (possibly leading to “universals”) [24]. For refinement, it is important to consider the benefits and limitations of the different approaches [27].

This study protocol aimed to describe a systematic and transparent method of adaptation and evaluation of an educational software tool. This favors method replication as it adds detailed descriptions of the reasoning of choices behind the steps of the method applied, with a separate manuscript focusing on the results [32]. The practices of open-
science aligns with transparency [33]. The research design selected was a qualitative content analysis [34,35] guided by the Delphi technique [36,37], participatory and iterative process framework for language adaptation (PIPFLA) [25], and Brislin’s foundational work [1,29] in cross-cultural instrument adaptation.

2. Methodology

The method of adaptation used was developed by coupling the rigor of systematic reviews, research synthesis, empirical research analysis, using Delphi elements of iteration and controlled feedback, and consulting translational sciences in regard to the back-translation’s purpose. The features of systematic reviews encompass specifying and explicit questions, conducting a comprehensive search, and rating the quality and strength of the quality of the evidence. Recent publications confirm the need of developing adaptation process considering the transferring across countries [22,38]. It should, furthermore, be noted that this method is adapting an intervention/education rather than it being a tool—this is why psychometrics and back-translation are not key components in this methodology, which innovatively uses processes across education, nursing, and cross-cultural adaptation.

During the search, the author located the theoretical framework of the cross-cultural equivalence model, which aims to combine emic and etic perspectives on a participatory and iterative process framework for language adaptation (PIPFLA) [1,25,29]. It considers the unique needs of intervention versus measurement such as time, resource constraints, and additional harmonization steps. The PIPFLA includes back-translation; however, after consulting translational sciences in regard to back-translation’s purpose, the author developed an adaptation of the PIPFLA framework (Figure 1).

Figure 1. Process to adapt safeMedicate from English to Portuguese.
The adapted model followed five dimensions that should be considered during the comprehensive cross-cultural equivalence model, semantic, content, technical, criterion, and conceptual [23], and considered the evaluation methods used to prepare language adaptations, which are informativeness, source language discrepancy, security, and practicability [25,39]. We opted to add triangulation of research methods to strength the validity of the adapted framework, as well as to present a detailed reasoning for approach and component choices. A suggestion of recruitment strategy, coding process, and data analysis is presented.

2.1. Recruitment Strategy

The recruitment strategy occurred through the snowballing sampling method [5,40–43]. The partners for safeMedicate adaptation were selected according to their role in the process: (i) For the language adaptation team, the inclusion criterion was the fluency in English and Portuguese so all members may understand and discuss the Portuguese and English content simultaneously; (ii) The panel of experts included only nursing professionals that have served as professors, supervisors of nursing students, and/or as clinical nurses; and (iii) The student panel was drawn from a list of the names indicated by the panel of experts: each expert indicated three students and one professional nurse. The participants were perceived as partners in safeMedicate’s adaptation process for use in Brazil rather than human subjects.

2.2. Strengthening the Quality of the Evidence: Triangulating Research Methods

We triangled face validity survey, focus groups, and journaling. The focus groups comprised the language adaptation team, panel of experts, and student panel. Journaling was used to gain a more in-depth perspective beyond the initial understanding of the research question, involving a cyclical process of doing–reflecting–learning [40,44]. By identifying and documenting motivations, interests, and perspectives initially and throughout the research process, the principal investigator consciously compared the final interpretation with what was first expected to be found, building the trustworthiness of the data.

2.2.1. Focus Groups

The primary investigator conducted semi-structured group interviews guided by the answers to the “safeMedicate form” related to the safeMedicate section (Figure S1) and the narrative interview guide adapted per committee [32]. This way, the members of the focus group were able to provide simultaneous feedback towards each part of the educational sections (Figure S1), while the primary investigator focused on identifying changes and participants’ general perceptions of the virtual learning environment [32]. If items came up in the focus group that were not consistent with the safeMedicate form (Figure S1) or the narrative interview guides [32], they were adapted as necessary using a project and cycle development spreadsheet (Figure S2).

The focus group members (language adaptation team and panel of experts) were perceived as partners on the adaptation process of SafeMedicate for use in Brazil instead of a human subject research. A well-known consensus-building method is the Delphi technique [45–47]; therefore, we also used elements of iteration and controlled feedback (using a structured group communication) from the Delphi technique to gather information from the panel of selected expert-subjects [36,37]. We used the RealTime Delphi, which allows expert feedback to be shared in real time [48].

The group meetings occurred through synchronous communications (videoconference calls) according to members’ availability, which was recorded. After the meeting, the data were synthetized and a cross-checking of recommendations was performed [49].

There are three criteria of reliability for a focus group: stability, equivalence, and internal consistency [41,50]. In regard to stability, the consistency of issues over time, the researcher identified members that committed availability to the entirety of the project, maintaining the consistency of experts. Equivalence emphasized the need for the con-
sistency of moderators. As such, the primary investigator acted as the moderator for all groups and communicated with team members of the language adaptation team and panel of experts regularly. In order to guarantee internal the consistency of the analysis, the primary investigator assumed the primary responsibility for conducting the analysis of which results were discussed with a second coder. The content validity of the focus group referred to the researcher assessing if the shared information was valid and consistent among group meetings. A recent publication advises on conducting online focus groups [51].

This method was used for the language adaptation team and panel of experts.

2.2.2. Language Adaptation Team

The language adaptation team merged two translations from the source language version to target language (English and Portuguese). One of the translations was produced by the primary investigator, a Brazilian nurse, and the other by a professional translator. The language adaptation team included a project staff member, as is described in Table 1.

Table 1. Language Adaptation Team.

| Translator 1: | Primary investigator; female; born and graduated nursing school in Brazil; worked as a professor in a Brazilian university; doctoral candidate at the University of South Florida, USA. |
| Translator 2: | Professional translator certified by the International Medical Interpreters Association (IMIA); prior experience translating medical information from English to Portuguese, but not a healthcare professional. |
| Project staff: | Female; born and graduated nursing school in USA; earned masters and doctoral degree at Texas Womans University, USA; professor in a Brazilian university for 30 years. |

2.2.3. Panel of Experts

The panel of experts evaluated the translations produced in the target language providing constructive feedback and suggestions, justifying them through sources like governmental and professional guidelines, articles, standardized medical language guides, etc. The panel of experts characteristics are described in Table 2.

Even though the meeting was scheduled with seven professionals, three cancelled at the last minute, resulting in a focus group with four members who followed up with subsequent contact and meeting. In general, a group with six to ten members is recommended, as a larger group may preclude everyone from interacting, and a smaller group may make members feel as they cannot speak freely or have to speak when they have nothing to offer [50,51]. However, in this study, due the professionals’ diverse and strong experience in the Brazilian nursing market and their comfort level showed during the videoconferences, it was clear that the professionals had no inhibition to contribute to the discussions.

The Portuguese version of safeMedicate achieved by the language adaptation team was presented to the panel of experts who provided feedback on the necessary adaptations. The adaptations suggested were presented to software developers and the feedback was presented to a panel of expert. Subsequent versions were created and presented again (following a cycle), two versions were created until the panel reached consensus, which lasted 6 months.
Table 2. Panel of Experts.

<table>
<thead>
<tr>
<th>Professional</th>
<th>Qualification and Experience</th>
</tr>
</thead>
<tbody>
<tr>
<td>Professional 1</td>
<td>MSN, RN; Brazilian nursing working in the market for 16 years, 8 years as clinical supervisor of nursing students, and 11 years as nursing professor.</td>
</tr>
<tr>
<td>Professional 2</td>
<td>MSN, RN; Brazilian nursing working in the market for 15 years, 10 years as clinical supervisor of nursing students, and 12 years as nursing professor.</td>
</tr>
<tr>
<td>Professional 3</td>
<td>PhD, RN; Brazilian nursing working in the market for 11 years, 11 years as clinical supervisor of nursing students, and 11 years as nursing professor (started as substitute professor becoming full professor for the last 3 years).</td>
</tr>
<tr>
<td>Professional 4</td>
<td>Nursing specialist, RN; Brazilian nursing working in the market for 23 years and 10 years as a nursing professor. This professional worked as nursing coordinator of various nursing programs for 19 years.</td>
</tr>
</tbody>
</table>

Note: Brazilian professors were chosen through a selection process based on curriculum, didactic skills, and market experience.

2.2.4. Student Panel

The student panel consisted of one nursing student and one professional nurse seeking update, who provided through individual conference calls a general evaluation of safeMedicate, providing critiques and suggestions. The group represents the target audience of the software. The semi-structured interviews were guided by safeMedicate sections (Figure S1). The participants were drawn from a list of the names indicated by the panel of experts: each expert indicated three students and one professional nurse. The 18 students and 6 nurses were invited to the student panel. The remaining students and nurse professionals who committed to participating were allowed access to the Brazilian version of safeMedicate and received the face validity survey (Figure S3).

2.2.5. Face Validity Survey

Face validity refers to the degree to which a test appears to measure what it purposes to measure. A face validity survey was presented to the target group (nursing students and professionals seeking an update) as an opportunity to reflect and evaluate the implementation of the instructional design as a whole. The survey (Figure S3) is an adaptation of a system usability scale, which has shown a strong face validity [52–54]. Internet platforms, university websites, and affective tutoring systems showed a good level of usability of the system usability scale [54], which aligns with the safeMedicate educational software delivery method. The survey focused on what they like about the various elements, what is helpful or not, if the materials and activities are appropriate for their needs, if they could, what changes would they make, and if they feel that they attained the objectives.

Lastly, we invited the students and professionals to participate in further adaptation/research of the software through a snowballing strategy; the researcher was able to build a contact database favoring future large-scale studies and adaptations.

2.3. Data Analysis

To explore the evaluation of safeMedicate and identify the adaptations necessary in the software for use in Brazil, transcripts from the group conference calls were subjected to content analysis [34,35]. A confederate name to protect the confidentiality of the partners of the conference calls was created.

Following the codebook development strategy [55], after the primary investigator developed the codebook, the primary investigator and a second coder independently coded the transcript of the first conference call. The second coder was a doctoral student trained in qualitative research with experience in cross-cultural research for five years. Both identified and sorted the statements referred to in the research question (which are the
adaptations necessary in safeMedicate for use in Brazil?). In cases where disagreement exists about a statement placement, both recoded referencing the Brazilian legal documents regarding medication training information. When no consensus was possible, the statement was placed into a residual category. In the study, both coders independently coded all videoconferences transcripts.

Descriptive statistics can be used to analyze and report the face validity survey data, calculating frequencies, measures of central tendency, and standard deviations. This method favors comparison to other system usability scales [54].

3. Results

In this study protocol, bilingual and expert committees are preferred over back-translations and a codebook development strategy is adopted. The final codebook with the list of recommendations and its respective quotes are published [32]. Here, we present the reasoning behind the cross-cultural equivalence model, how data trustworthiness was established, and how the coding process was developed.

3.1. The Cross-Cultural Equivalence Model

Even though back-translation has been a common step in the cross-cultural adaptation of instruments [1,56,57] and is included in the 11-step process of PIPFLA, the back-translation benefit of providing information about semantic and conceptual equivalence has been questioned in translation science [58–60]. Moreover, the international medical interpreters association does not recommend back-translation [61], and the use of expert committee helps to ensure accurate content [62].

Additionally, even though the back-translation method has frequently been used to maintain content equivalence in the translated version, traditionally it has been used with instrument validation [20]. The approach’s major weakness is its inability to estimate the number of independent bilingual translators that are needed to obtain content equivalence [63], and that the acculturation of bilingual participants enables them to report different responses from those who are monolingual (target population), even though the two versions have content equivalence, because bilingual people are acculturated to their host culture [64–66].

The argument is that the comparison of an original source text and a back-translated source provides only limited and potentially misleading insight into the quality of the target language text. This happens because many adaptations made by the translator, which perfectly convey the meaning of the original, are lost in the back translation, giving the appearance of an inaccurate rendition [61,67]. It is recommended that instead of looking at two source language texts, it is much better in practical and theoretical terms to focus attention on first producing the best possible translation and then directly evaluating the translation produced in the target language, rather than indirectly through back-translation [62,67].

Consequently, we adjusted the process of translation and adaptation of the PIPFLA model according to the recommendation of producing the best possible translation and directly evaluating the translation produced in the target language, rather than indirectly through back-translation [62,67].

Throughout the years, measurement tools and interventions have been translated and adapted [57,68]. However, not all programs describe the translation and adaptation process in enough detail to replicate [69–72]. Although studies incorporate systematic approaches of language adaptation process in various degrees, the source is not often cited [25]. As such, a strength of this method is the transparent nature in which safeMedicate was adapted. Specifically, Figure 1 illustrates the adaptation and evaluation processes that were used, representing an adaptation of PIPFLA. That is, the back-translation steps were removed as previously described.

Additionally, this study protocol considers not only the adjustment to the Brazilian culture, but also the system. This was performed by, additionally to the professional translation, including healthcare professionals in the bilingual committee and having
one translated version created by a bilingual healthcare professional (nurse). This need was identified even in recent publications that used only professional translators in the adaptation process [22].

In order to strengthen the methodology, the PIPFLA’s process results were based on the triangulation of three methods (focus groups, interview, and face validity surveys) and considered the evaluation methods used to prepare language adaptations, which are informativeness, source language discrepancy, security, and practicality [25,39], each described below.

While informativeness relates to the semantic and conceptual equivalence of the language adaptation, source language discrepancy discloses discrepancies and translation ambiguities that need to be addressed. Both will be addressed in the process of forward translation (Step 2), as well as at each harmonizing step (Steps 3, 5, 7, and 9), which includes the language adaptation team.

While security consists of mechanisms used to increase confidence in the quality, usability, and experiential equivalence of the language adaptation, practicality refers to the feasibility and affordability of the process. Both criteria will be assessed during the harmonizing steps (Steps 3, 5, 7, and 9), and during reviews performed by the panel of experts (Step 4), student panel (Step 6), and face validity by target group (Step 8).

Informativeness, source language discrepancy, security, and practicality will also be evaluated during proofreading (Step 10) and consolidation of the final language adaptation (Step 11).

3.2. Establishing Trustworthiness of Data

The fundamental criteria for the trustworthiness of the data in qualitative research is credibility, dependability, confirmability, and transferability.

In order to guarantee credibility, the principal investigator explored the correct operational measures for the concept being studied [40,73,74] through the triangulation of methods (journaling, focus group, and face validity survey), resulting in contextually rich interpretations.

Dependability refers to finding logically consistent patterns of response that remain reasonably stable over time [40,73,74]; this is guaranteed by having a second independent coder helping to offset the subjective bias of the researcher. In addition, journaling contributes to this criteria by describing detailed decision steps of method changes, question revisions, and so forth.

In regard to confirmability, which goal is to confirm the data reflects as accurately as possible the participants’ perspectives and experiences [40,73,74], the principal investigator allowed the audit trail. The journaling, focus group guides, list of codes, and reports enable the tracking of the process that has led to the conclusions. Consequently, they allowed opening the study process to outside inspection and verification, in other words, the auditing of the process.

Transferability in qualitative research refers to producing data that are conceptually, not statistically, representative of people in a specific context [40,73,74]. In pursuance of transferability, the partners of safeMedicate adaptation were carefully selected to represent viewpoints and experiences that reflect key issues in the research problem. For this reason, the snowball sampling method was performed guaranteeing an intensity (professionals with particular experience in the topic) and heterogeneous sample (the inclusion of professors and clinical nurses in the focus groups highlights the variation perspective of the phenomena).
3.3. Coding Process

The systematic coding of text is one of the key elements in the qualitative data. Codes are the foundation of an analyst argument based on the building blocks of theory or model building. The codebook development strategy standardized structure and dynamic process typifies the project undertaken at CDC, where coding is generally performed by two or more people who may be located at widely dispersed sites [55].

The CDC project work frame aligns with the process of adapting an educational software internationally. Therefore, considering that a structure codebook provides a stable frame for the dynamic analysis of contextual data, it can improve intercoder agreement among multiple researchers, and take into account the value of team-based codebook developing and coding, the researcher opted for the codebook development strategy.

The coders examined patterns and possible relationships in these themes, contradictory responses, or gaps in understanding. It was important that coders were guided by what is most useful as they organize and make sense of the text, documenting coding decisions and keeping in mind coding schemes is never rigid, but evolves over time. The process of continuous coding imposes a systematic approach, and keeping track of gaps is important as they suggest new questions for further explanation, leading to adapting the study design, seeking different sources, or modifying discussion guides to explore new topics [40]. Therefore, the interview guides were discussed based on continuous data analysis, which have undergone minor changes to produce the most accurate description of the phenomenon being studied: the adaptations necessary in safeMedicate for use in Brazil. Though the structure is simple and stable, the process of building is complex and dynamic as the codebook is reviewed and refined according to the data analysis. Figure 2 illustrate the coding process diagram, which is subject to review in case of inconsistencies.

![Figure 2. Coding flow diagram. Adapted from source: [55].](image)
The codes derive from a priori and emergent themes. A priori reflects what the researcher expects to encounter from the research questions and the emergent themes are codes that emerge after the data collection. There were two rounds following the coding process diagram to achieve the final codebook, which is published with the results/quotes [32]. In addition, the principal investigator noted the ideas in the field journal, recording any topics that the research has not adequately addressed up to the present and ones that emerged unexpectedly in the transcripts, allowing the audition of the trail.

4. Discussion

Neither systematic reviews nor empirical research currently published describe the method used with enough details to allow methodology replication or improvement. The adapted process of PIPFLA described in this paper uses a standardized and transparent documentation, including expert judgment. It contributes to reduce bias and provides a systematic and rigorous approach. Shortening the adaptation time of an effective evidence-based training is important and necessary worldwide. This study protocol is characterized by the preference for bilingual and expert committees over back-translation, to favor the accuracy of content [62,67], and the use of the codebook development strategy. A strategy adopted by the Centers for Disease Control and Prevention (CDC) for when coders are in widely dispersed sites and whose development of the initial code list happens prior to analysis [55].

To uptake systematic and transparent cross-cultural adaptation processes allows not only for the optimization of education research resources worldwide, but also favors the spread of effective evidence-based training tools.

4.1. Limitations

A limitation of the adapted PIPFLA method is how challenging it may be to reach consensus on risk of bias for human observational studies. Exploring the outcome differences according to different research designs is also important as the quality rating varies according to the methodology (i.e., case–control studies, cross-sectional studies, case series reports, cohort, nested case–control studies). The application of the adapted PIPFLA process may be poorly executed by other researchers as generating questions relevant to decision-making throughout the adapted PIPFLA process is crucial to cover pertinent information. However, publishing a detailed step-by-step instruction may be helpful in avoiding a methodology fallout. Finally, there are many other puzzling nonscientific, social, and political barriers to cross-cultural adaptation processes.

4.2. Future Directions

Assessing the average time necessary for total process completion is important for future researchers and intervention developers. The recruitment and data analysis suggestion allows flexibility for future adaptation efforts. This flexibility was deliberately proposed as an improved statistical tool for data analysis, and the integration may contribute to advance the application of this adaptation process, favoring the ongoing development of research synthesis. Therefore, the broad applicability of the adapted PIPFLA process supports efforts by businesses, governments, and researchers.

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